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MODULAR AIR DEFENSE EFFECTIVENESS MODEL, PROGRAM DOCUMENTATION AND USER'S GUIDE

Volume II—MADEM Programmer Manual

The BDM Corporation
7915 Jones Branch Drive
McLean, Virginia 22102

31 January 1980

Final Report for Period 1 March 1979—31 January 1980

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This document is one of three volumes which provide documentation and user guidelines for the Modular Air Defense Effectiveness Model (MADEM). The three volumes are: VOLUME I—MADEM Analyst Manual; VOLUME II—MADEM Programmer Manual; and VOLUME III—MADEM Enhancement Specifications.

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PREFACE

The purpose of this manual is to document the Modular Air Defense Model (MADEM) and its implementation. The manual discusses the software architecture, data structures and execution requirements in detail.

The manual is intended for use by programmers charged with maintaining or modifying MADEM. The MADEM Analyst Manual discusses the processes modeled, their structure and relationships, and the various assumptions made.

TABLE OF CONTENTS

Section		Page
	PREFACE	1
	LIST OF ILLUSTRATIONS	5
I	INTRODUCTION	7
II	SOFTWARE ARCHITECTURE	8
	A. Introduction	8
	B. Implementation Language	8
	C. Data Structures	9
	D. Simulation Control	9
	1. Top Level Control	9
	2. Initialization	13
	3. Storage Management	13
	4. Event Control	14
	E. Diagnostics	17
	1. Debug Routines	17
	2. Data Structure Display Routines	19
	F. Software Components	20
	1. Processor Configuration	20
	2. Preprocessor Functions and Subroutines	22
	3. Main Processor Functions and Subroutines	26
	4. Postprocessor Functions and Subroutines	34
III	DATA STRUCTURE DOCUMENTATION	35
	A. Introduction	35
	B. Common Blocks	40
	C. Data Base Structure-DATFILE	47
	1. Data Block Index	47
	2. Description	47
	3. Structure Overview	48
	4. Block Specifications	50
	5. Linkages to Other Data Structures	59
	6. Notes	60

TABLE OF CONTENTS (CONTINUED)

Section		Page
III	D. Simulation Control Structures	61
	1. Event Lists	62
	2. Hex Address Tree and Related Lists	66
	E. Command/Control Structures	71
	1. Player Lists	72
	2. C2 Trees	78
	3. Passive Target List	86
	F. RED Structures	89
	1. Red Theater Commander	90
	2. Potential Target List	98
	3. Assigned Target List	103
	4. Nonavailable Target List	109
	5. Corridor Description List	114
	6. Attack Requirements/Allocations Lists	121
	7. Red Air Bases	130
	8. Red Flights	137
	G. Blue Structures	153
	1. Allied Tactical Air Force (ATAF)	154
	2. Sector Operations Centers (SOC)	159
	3. Combat Reporting Centers (CRC)	164
	4. Blue Airbases (B-AB)	175
	5. Blue Flights (B-FLT)	182
	6. Battalion Operations Centers (BOC)	198
	7. Sam Battery (BTRY)	215
	8. Passive Targets (PT)	231
	H. Storage Space Management	235
	1. Data Block Index	235
	2. Description	235
	3. Structure Overview	235
	4. Block Specifications	238
	5. Linkages to Other Data Structures	238
	6. Notes	238

TABLE OF CONTENTS (CONTINUED)

Appendices		Page
APPENDIX A	Executive Requirements	239
APPENDIX B	Modular Information Data Access System (MIDAS)	263
APPENDIX C	The Program Design Language	281
APPENDIX D	MIDAS Tables	291
APPENDIX E	The Dynamic event scheduling Algorithm	303
APPENDIX F	MADEM Event Code Definitions	311
APPENDIX G	Random Number Generator Calls	317
APPENDIX H	MADEM Subroutine Reference Lists and Calling Hierarchies	319
APPENDIX I	MADEM Debug Routines	469
APPENDIX J	MADEM Data Structure Cross Reference	481

LIST OF ILLUSTRATIONS

Figure		Page
II-1	Top Level Subroutine Calling Hierarchy	10
II-2	Event Control Subroutine Calling Hierarchies	15
II-3	Event Processing Overview	16
II-4	MADEM Processor Configuration	21
III-1	Data Base Structure Diagram	49
III-2	Discreet Event List Diagram	63
III-3	Hex Tree Structure Diagram	67
III-4	Player List Structure Diagram	73
III-5	C2 Tree Structure Diagram	79
III-6	Blue Command/Control Structure	84
III-7	Red Command/Control Structure	85
III-8	Passive Target List Structure Diagram	87
III-9	Red Theater Commander Structure Diagram	91
III-10	Potential Target List Structure Diagram	99
III-11	Potential/Assigned Target List Structures	102
III-12	Assigned Target List Structure Diagram (Red Commander Perception List)	104
III-13	Nonavailable Target List Structure Diagram	110
III-14	Attack Sectors	113
III-15	Corridor Description List Structure Diagram	115
III-16	Relationship of HEX LINK Lists to Corridor Boundaries	120
III-17	Attack Requirements/Allocations List Structure Diagram	123

LIST OF ILLUSTRATIONS (CONTINUED)

Figure		Page
III-18	Red Air Base Structure Diagram	131
III-19	Red Flight Structure Diagram	139
III-20	Flight Data Base Structure Diagram	140
III-21	Allied Tactical Air Force Structure Diagram	154
III-22	Sector Operations Center Structure Diagram	159
III-23	Combat Reporting Center Structure Diagram	165
III-24	Blue Airbase Structure Diagram	176
III-25	Blue Flight Structure Diagram	184
III-26	Flight Data Base Structure Diagram	185
III-27	Battalion Operations Center Structure Diagram	200
III-28	Digested Information List Configurations	201
III-29	Digested Information List and Perception List	201
III-30	SAM Battery Structure Diagram (HAWK and HERC)	217
III-31	SAM Battery Structure Diagram (PATRIOT)	217
III-32	BTRYDIL Configurations	218
III-33	Battery BTRYDIL Perception List Association	219
III-34	Passive Target List Structure Diagram	232
III-35	I-Space Array Configuration	236
III-36	Garbage Collection Matrix Structure Diagram	237

CHAPTER I

INTRODUCTION

The purpose of this manual is to document the MADEM Software Architecture. It is designed for use by programmers charged with maintaining or modifying MADEM. Those wishing to use MADEM in a study are referred to the MADEM ANALYST MANUAL.

Chapter II of this manual provides an overview of the MADEM Software Architecture. Its' primary objective is to associate particular subroutines with particular simulation control and modeling functions. A secondary objective is to provide a basic explaination of the data storage system used in MADEM. A general knowledge of the subroutines combined with an understanding of the data storage system provide a context within which the more detailed information in Chapter III, the Appendices and the Source Code may be used.

Chapter III of this manual contains detailed Data Structure Documentation. This information is crucial to an understanding of the MADEM Software. MADEM uses a complex list processing system to store and retrieve data. In this system the relationship among various blocks of data is as important to the functioning of the software as the contents of the blocks. Groups of related data blocks form data structures which, in effect, "drive" the software. Therefore, it is impossible to understand the Source Code without a clear picture of the data structures and their contents.

CHAPTER II
SOFTWARE ARCHITECTURE

A. INTRODUCTION

The primary objective of this chapter is to associate particular subroutines with the model functions they control. A secondary objective is to introduce the user to the data storage system used in MADEM. More detailed information on subroutines and data structures is contained in the Appendices, the Source Code and in Chapter III of this report.

B. IMPLEMENTATION LANGUAGE

MADEM was implemented in accordance with principles of topdown structured programming. Prior to code generation, the MADEM design was specified in a BDM developed Program Design Language (PDL). The concepts and procedures involved in the use of PDL are discussed in Appendix C. In essence, the PDL for a given subroutine constitutes the equivalent of a logic flow diagram for the subroutine. The PDL for each MADEM subroutine appears in the source code. Information on the basic purpose, the inputs and outputs, and the calling interfaces for each subroutine is given in Appendix I. The overall model structure is reflected by the subroutine call diagrams in Appendix J.

The design specified by the MADEM PDL was implemented in FORTRAN. A special precompiler was used to allow convenient access to MADEM's many dynamically allocated data blocks. This precompiler is the BDM developed Modular Information Data Access system (MIDAS), which is described in Appendix B. MIDAS provides two important capabilities. The first allows automatic replacement of specified one line macro-instructions by corresponding sets of FORTRAN instructions. This feature is used to insure uniformity in the definition of named COMMONs from routine to routine. The second important MIDAS capability allows reference by name to elements of dynamically allocated data blocks. Thus, for example, MIDAS may permit a

reference of the form $P.TYPE.RATE$ to be used in place of a corresponding FORTRAN reference ITR(ITR(P+L)+5), where P has been declared a pointer to a data block of a type known to MIDAS.

C. DATA STRUCTURES

Most of the data employed by MADEM is stored internally in data blocks dynamically allocated from various storage arrays. Many types of such blocks are employed, each having a block name and most having a set of element names (and types) known to the MIDAS translator. Having established a pointer to such a block and having indicated the block type in a MIDAS "DECLARE" statement, a programmer may then reference any entry in the block by name. Chapter III presents descriptions for all of the MADEM data block types; the MIDAS name for each block is given, along with comments on the use of the block within the simulation. The name, type, and meaning (use) of each element of the block is also given. The structure and contents of each type of data block as implemented in MIDAS code is also indicated in Appendix E.

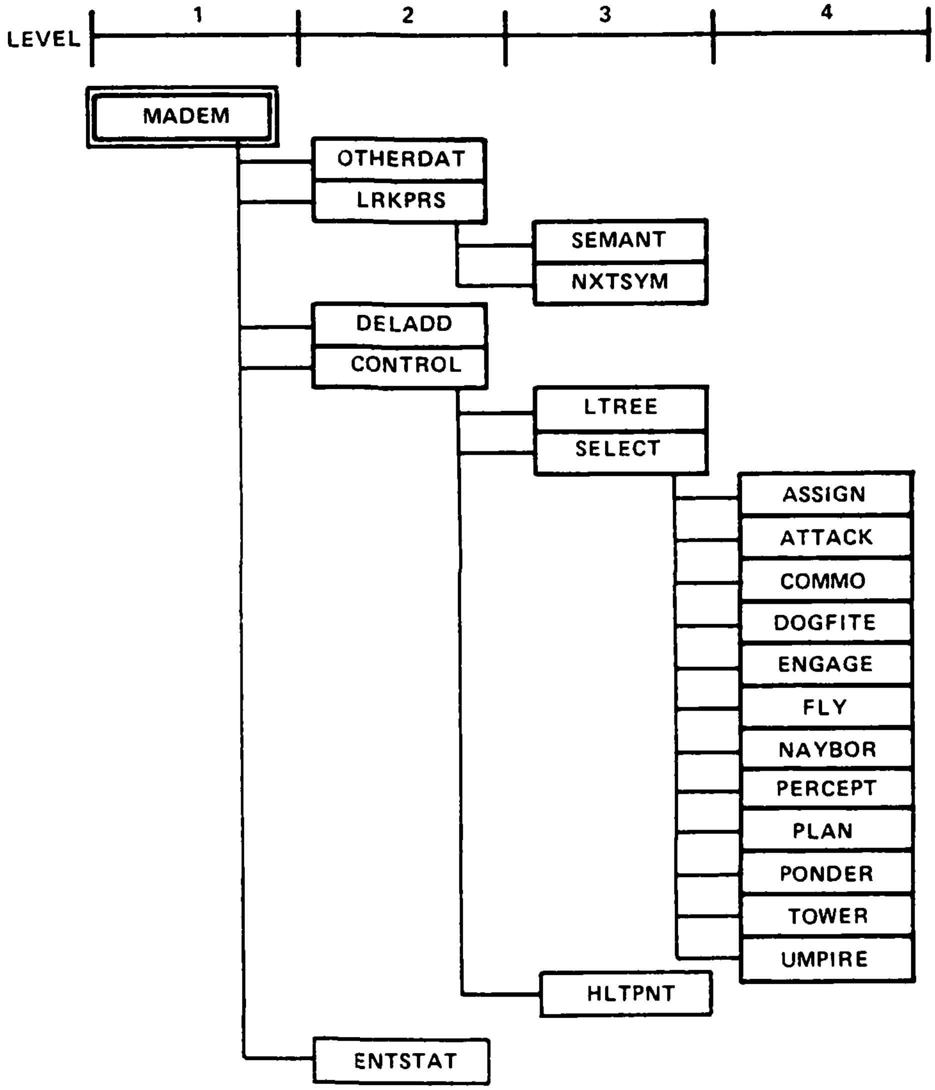
In addition to common storage arrays for dynamically allocated data blocks, MADEM employs a number of other named COMMON storage areas for holding simulation control information and temporary working data. Chapter III presents each of the COMMONs and indicates the meaning (use) of each element.

D. SIMULATION CONTROL

The purpose of this section is to discuss Simulation Control and Management Functions within MADEM and to associate particular subroutines with these functions.

1. Top Level Control

The Top Level Control routines for MADEM are shown in Figure II-1. MADEM is the main routine which invokes the four major control routines; OTHERDAT, LRKPRS, DELADD, and CONTROL. At the users option MADEM



NOTE: ONLY SUBROUTINES WHOSE PRIMARY FUNCTION IS CONTROL HAVE BEEN INCLUDED IN THIS DIAGRAM. FOR A COMPLETE CALLING HIERARCHY SEE APPENDIX J.

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Figure II-1. Top Level Subroutine Calling Hierarchy

may also invoke ENTSTAT which provides a variety of subroutine diagnostics at various points in program execution.

OTHERDAT controls input to the (NON-UOIL) Data Base. The contents and structure of this data base are described in detail in Chapter III of this report. The data input procedure is documented in Chapter IV of the MADEM ANALYST MANUAL.

LRKPRS controls semantinc processing of the User Oriented Input Language (UOIL) inputs. The data structures which are built from these inputs are discussed in Chapter III of this report. The Input Language and data requirements are documented in Chapter IV of the MADEM Analyst Manual. LRKPRS invokes two secondary control subroutines- SEMANT and NXTSYM. LRKPRS and NXTSYM parse the input sentences and convert them to "ICODES" which are passed to SEMANT. SEMANT converts these "ICODES" to data structures of various kinds. Users are cautioned to avoid modifications to LRKPRS, NXTSYM and SEMANT unless they are well versed in semantic processing techniques.

DELADD controls processing of descrete events in MADEM. It adds "events" to a Leftist EVENT TREE structure which is used to sort events scheduled by the various program modules. Events control is discussed in further detail in section of D.4 and in Appendix E. of this manual.

CONTROL invokes three major control subroutines- LTREE, SELECT, and HLTPNT. LTREE removes "EVENTS" from the EVENT TREE constructed by DELADD. Events are removed and processed in order of their occurance. These "EVENTS" are then processed by SELECT. Based on an internal coding system for EVENTS, (see Appendix F) SELECT invokes one of nine program modules. Each of these modules (represented in Figure D-1 by their main control routines) performs all of the functions required by the EVENTS. The functions of each module are summarized in Table II-1. Additional information on each module is provided in Section F.3, and Appendix I of this Manual as well as in the source code. If a Termination of Simulation event is found by LTREE, the simulation termination subroutine HLTPNT is invoked by CONTROL. HLTPNT controls printing of termination messages and output files to be stored for subsequent use by the main processor and post processor.

TABLE II-1.

MADEM MODULE SUMMARY

MODULE CONTROL/ROUTINE		FUNCTION
ASSIGN	-	COMBAT REPORTING CENTER MAKES OF INTERCEPTORS TO RED FLIGHTS
ATTACK	-	CARRY OUT GROUP ATTACK BY RED FLIGHTS
COMMO	-	COMMUNICATIONS TRANSMISSION
DOGFITE	-	AIR TO AIR COMBAT PROCESSES
ENGAGE	-	SURFACE TO AIR MISSLE ENGAGEMENT DECISIONS
FLY	-	AIRCRAFT MOVEMENT
NAYBOR	-	DETERMINE NEARBY UNITS AND SCHEDULE ALL UNITS FOR A CHANCE TO "SEE" AN ACTION
PERCEPT	-	CONTROLS PERCEPTION OF OTHER UNITS
PLAN	-	RED THREAT PLANNING
PONDER	-	UNIT INFORMATION PROCESSING
TOWER	-	AIRBASE OPERATIONS
UMPIRE	-	SIMULTAINEOUS EVENT CONTROL

2. Initialization

The subroutines devoted solely to initialization are:

(1) BDALT

(2) BDLEX

(3) BDLRK

(4) BDPARS

(5) BLKDAT

(6) FETCH

All but one of these (BLKDAT) are used only by the Lexical Analyzer Routines. They contain parsing tables which are essential to the UOIL decoding process. BLKDAT is used to initialize the MADEM main routine. FETCH reads input data files for the main routine.

3. Storage M agement

To provide maximum flexibility in the types of scenarios which can be handled by MADEM, a system of dynamic storage allocation is employed. The majority of data in MADEM is stored in a single array (ISPACE, or SPACE) from which storage space is dynamically allocated. Thus, deletion of data of one type frees space for data of other types. The subroutines exclusively devoted in storage allocation are:

(1) GIMME

(2) RELEASE

(3) RELIST

subroutines GIMME and RELEASE are the general purpose storage management routines employed in MADEM. To obtain a data block of length N (N=1-20) the statement.

Call GIMME (P,N) is used. The return value P is a pointer to the allocated block (address of the first word of the block in the ISPACE array). When the block is no longer needed, the statement.

Call RELEASE (P,N) releases the block for subsequent reallocation. The released block is placed in a garbage collection matrix (see Chapter III .H) which consists of lists of blocks of various sizes. When a block of a given size is required, GIMME searches this list to find a release block of the desired size before it allocates virgin storage space.

Because very large blocks are seldom called for, released blocks over 20 words long are broken down into more commonly used four word blocks by the subroutine RELIST. Further details on storage space management are contained in Chapter III of this manual.

4. Event Control

Since MADEM is an event stepped simulation, the management of notices for pending events is an important component of simulation control. The following subroutines are devoted to this function:

(1) DELADD

(2) LTREE

DELADD is used to add events to a quisisorted LEFTIST EVENT TREE in which the nearest events in time are placed closest to the top of the tree. The top event block on the tree always contains the next event code to be processed. LTREE is used to extract a pending event from the EVENT TREE. The calling hierachies of DELADD and LTREE are illustrated in Figure II-2.

DELADD invokes three subroutines - GIMME, SNAP, AND LTRMRG. GIMME allocates storage space for the new event block, SNAP adds the newly created block to the event tree, and LTRMRG sorts the event tree to place all of the event blocks in the correct order with respect to the top of the tree.

LTREE removes the event block from the tree, passes the event code stored in the block to SELECT and releases the storage space formerly used by the event block by invoking the subroutine RELEASE.

An overview of event processing is shown in Figure II-3. Event blocks are added to the event tree as actions are taken by the various program modules invoked by SELECT. SELECT is in turn driven by event codes extracted from the event tree by LTREE. This process continues throughout the simulation until a termination event is found by LTREE. When this occurs, HLTPNT is called by CONTROL and the simulation is HALTED. Detailed documentation of this dynamic event scheduling algorithum as well as a listing of event codes may be found in Appendices E and F of this manual.

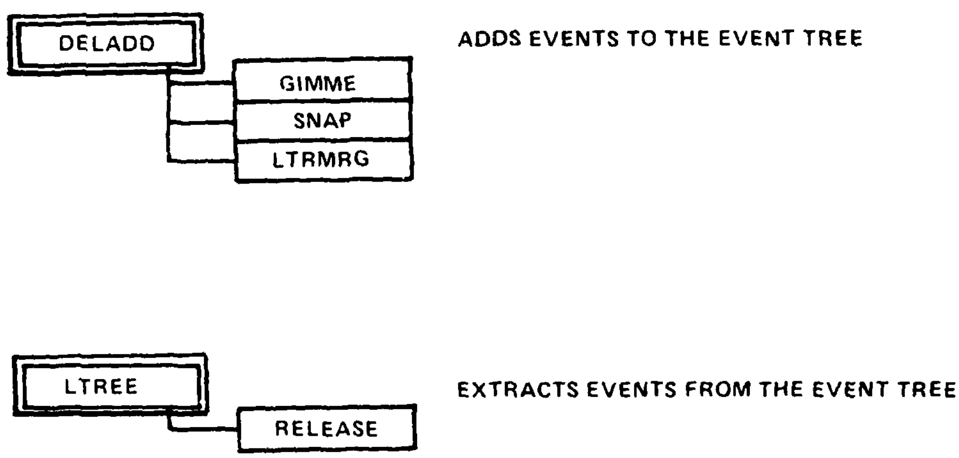

Figure II-2. Event Control Subroutine Calling Hierarchies

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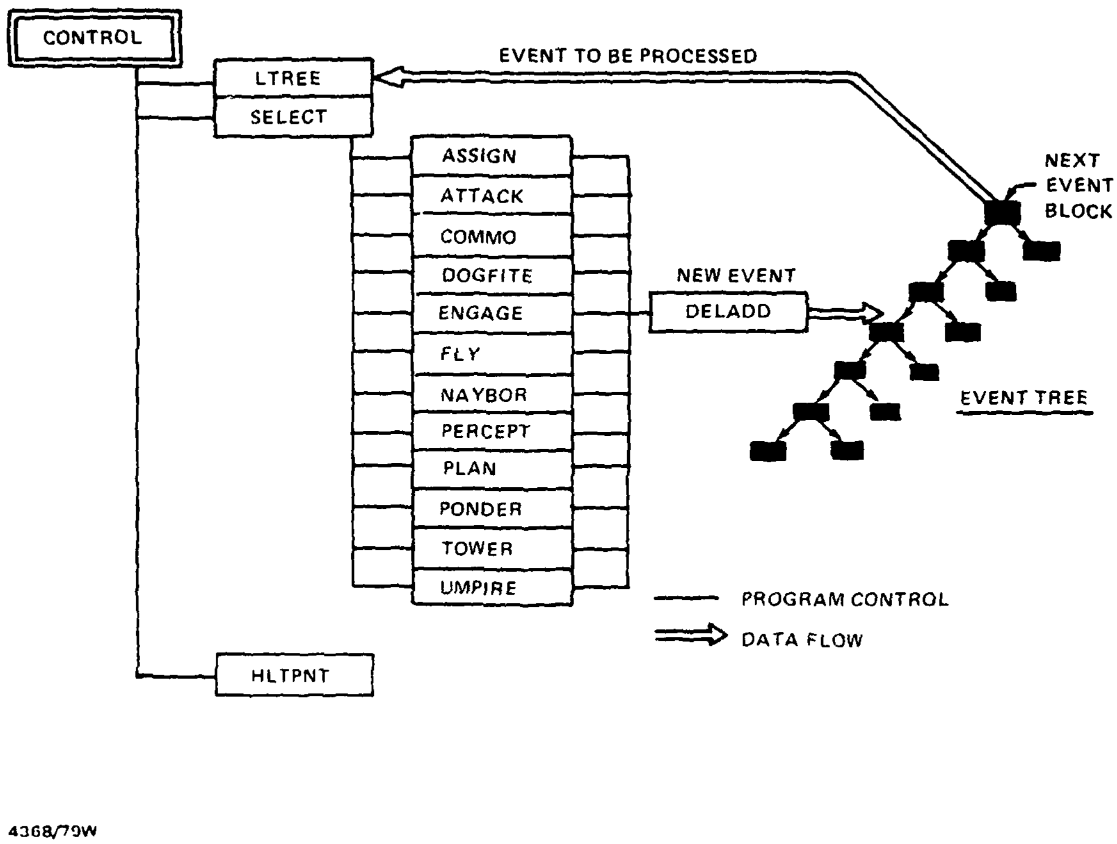

Figure II-3. Event Processing Overview

E. DIAGNOSTICS

The purpose of this section is to document the diagnostic capabilities which have been built into the MADEM software. A working knowlege of these debug and data structure display routines is essential to anyone who must maintain or modify MADEM. The operation of all diagnosis subroutines is discussed in detail in Appendix J of this report.

1. Debug Routines

There are over 300 subroutines in the current version of MADEM. A program of this size cannot be developed and maintained without some resident debug and error recovery capability built into the software. In MADEM the following subroutines are devoted to this function:

ENTRYP	DBGREAD
EXITP	HALT
ENTSTAT	ICHECK
RECOVR	ITRAP
RECCON	
RECER	
ROUTER	

MADEM's resident debug capabilities are based on the subroutine entry and exit tracking routines ENTRYP and EXITP. ENTRYP and EXITP are called at the beginning and end of nearly all routines in MADEM. Together they construct a circular list and pushdown stack of subroutine calls. They also construct a vector of subroutine entry counts and a corresponding vector of cumulative subroutine execution times. The circular list and pushdown stack allow the user to track the execution of all subroutines and to pinpoint fatal error locations. The vectors of entry counts and execution times provides useful information on re usage and efficiency of subroutines. At the user's option ENTRYP and EXITP will print out subroutine entry and exit messages for specified subroutines during normal program execution. Also at the user's option, ENTRYP and EXITP will call debug routines ICHECK and ITRAP (explained below) for specified subroutine calls to ENTRYP and EXITP.

A frequent list processing bug involves a zero or one digit ISPACE pointer. For this reason, the first ten words of ISPACE are reserved for nonuse, and should always be zero when none of these bugs occur. Debug routine ITRAP checks that area of ISPACE and stops the simulation by calling HALT whenever nonzero values are found there.

If it is desired to find out when other locations in ISPACE change value, debug routine ICHECK can be used. ICHECK holds pointers to up to ten ISPACE locations, as defined by input parameters on each run. Any time one of these ISPACE locations has a change in value, a one line message is printed indicating the old value, the new value, and the routine being executed when the change was noticed.

The vectors of subroutine entry counts, cumulative and average execution times, and flags indicating the ENTRYP and EXITP options specified are printed by ENTSTAT.

RECOR is a CDC System routine which is automatically activated within MADEM, but may be turned off at the user's option. It allows the program to regain control at the time that abnormal job termination would otherwise occur. It calls the MADEM subroutine RECCON in the event of catastrophic program failure.

RECCON can only be activated by RECOR. RECCON calls HALT, which stops the simulation and prints debug information.

ROUTER, which can be called from any routine, prints the subroutine name, the circular list subroutines called, and the pushdown stack containing the calling hierarchy.

RECER is the same as router except that RECER does not know the calling subroutine's name.

DBGREAD is the subroutine that reads, interprets, and processes all the debug input parameters that may be specified for each run. See Appendix J for further details.

HALT is the routine that is called whenever the simulation is to be stopped, whether it be abnormal or normal terminations. HALT saves the HOLD files and calls the appropriate subroutines to print valuable debug information. HALT prints the name of the 1st routine executed as well as

the reason for termination, the game time of the simulation, and the number of events executed in the volume. HALT then calls the following routines:

TRACE	-	prints current calling hierarchy
RECER	-	(see above)
ENTSTAT	-	(see above)
CLIST	-	prints key pointer values
ISDUMP	-	if selected, prints entire ISPACE array.

2. Data Structure Display Routines

Because of the complex nature of the data structures used in MADEM and their importance to the operation of MADEM subroutines, a series of data structure and common block display subroutines have been developed. These subroutines include the following:

CLIST
ISDUMP
DISPOAT
NIPULATOR

CLIST is used to print out the contents of all major common blocks used in MADEM. Key information contained in these blocks includes array dimensions and pointer values. ISDUMP is used to print out the contents of the dynamic storage array ISPACE within which all data structures reside. The outputs from CLIST and ISDUMP may be used to manually trace data structures in ISPACE.

However, since manual data structure tracing rapidly becomes time consuming and error prone, a variety of automated data structure display subroutines have been constructed. The two foremost of these are DISPDAT and NIPULATOR. DISPDAT outputs a formatted display of the DATA BASE STRUCTURE, the EVENT TREE STRUCTURE and specified portions of ISPACE.

In addition to the above display subroutines, a series of data block display subroutines has been developed which allows the user to build "custom" data structure display systems to suit special needs. Each data block has its own display subroutine which can display the block or all blocks in a linked list at the user's option. These block display subroutines can be placed under the control of special purpose control routines

developed by the user. User supplied control subroutines combined with the block display subroutines constitute a "modular" data structure display system which can be reconfigured at the user's option. Further details are provided in Appendix J.

F. SOFTWARE COMPONENTS

The purpose of this section is to introduce the reader to the major components of the MADEM software system. Detailed operating instructions may be found in Appendix A of this manual and Chapter IV of the analyst manual.

1. Processor Configuration

MADEM has three major software components - a preprocessor, a main processor, and a postprocessor. The overall configuration of these processors and their input and output files is illustrated in Figure II-4.

The preprocessor (sometimes referred to as INITBIN) reads user inputs, which include the data base and red threat planning specifications, translates these inputs into appropriate data structures and carriers out the red threat planning process. The resulting red attack plan is then saved on a "HOLD FILE" for subsequent use by the main processor also outputs a printed summary of the red attack plan and a 'HISTORY FILE". The HISTORY FILE contains a record of unit creation events whcih can be used by the postprocessor to construct summary tables of the types of units created.

The main processor (sometimes referred to as RUNBIN) is used to simulate the actual combat processes which result from the red attack. The main processor is run in a cyclical fashion. The initial main processor run is made using the RED ATTACK PLAN HOLD FILE as input. Combat processes are then carried out for approximately one hour of game time after which execution is terminated and as HOLD FILE containing the status of all units at the end of the hour is output. This HOLD FILE then becomes the input for the next main processor cycle. Each of these main processor cycles is referred to as a volume. As many volumes can be run as one required to simulate the desmed duration of conflict. However, the validity of the

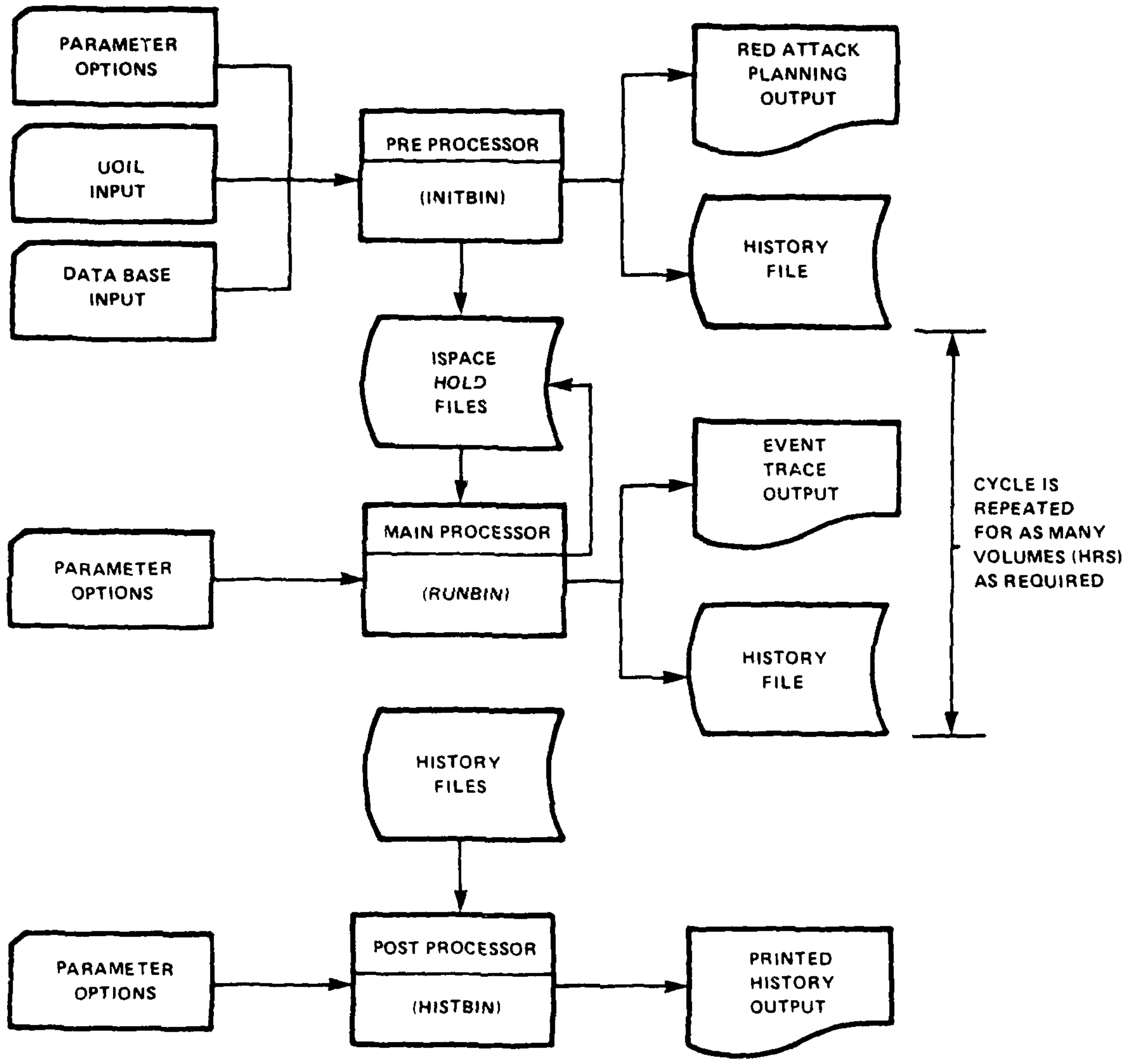

Figure II-4. MADEM Processor Configuration

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simulation probably declines rapidly after 8-11 hours of combat. The main processor also outputs an EVENT TRACE and a History File. The EVENT trace records all of combat events which occured during the volume. The History File contains a record of key events which can be used by the postprocesser to summarize the battle.

The postprocessor (sometimes referred to as HISTBIN) reads History Files output by the preprocessor and main processor and outputs a variety of tabular summaries of the battle. These outputs include the following:

(1) Red Aircraft acquired by Blue Defense Units

(2) Red Aircraft engaged by Blue Defense Units

(3) Red Aircraft damaged by Blue Defense Units

(4) Blue Units damaged by Red Aircraft

(5) Weapon System expenditures by Unit Type

(6) Number of Red Aircraft to reach Targets

(7) Number of Units created by Type

2. Preprocessor Functions And Subroutines

The following lists summarize the functions carried out by various preprocessor subroutines. Low level utilities have been deleted from these list. For a complete calling hierarchy and detailed subroutine documentation see Appendices I and II, and the Source Code.

a. Top Level Control Routines

MADEM	-	Main Routine
OTHERDAT	-	Constructs Simulation Data Base
LRKPRS	-	LR(K) Parser
SEMANT	-	Semantic Processing of UOIL
CONTROL	-	Event Control
SELECT	-	Selects Appropriate Event Module
PLAN	-	Red Threat Planning
HLTPNT	-	Halts Simulation
ENTSAT	-	Simulation software Use Statistics

b. Simulation Data Base Construction

OTHERDAT	-	Controls Construction of Data Base
ADDBLOK	-	Adds a Data Block to the Top of a Singly Linked List Structure
FINDBLOK	-	Finds a Data Block with a Specified Value in a Singly Linked List Structure

c. Semantic Processing Of UOIL

SEMANT	-	Controls Semantic Processing
CODE01	-	Initialized Hex and C2 Trees
CODE03	-	Constructs C2 Tree and Related Structures
SRCHPL	-	Searches the Players List
LOADPL	-	Enters a Unit onto the Players List
ABQUEVE	-	Sets up Airbase Data Structures
ADASASS	-	Constructs CRC, BOC and BTRY Structures
SCHTAB	-	Sets Hex Altitude From Altitude Data Base
CODE05	-	Constructs Hex Tree and Related Lists
VOLLOAD	-	Places a unit on a Hex's Unit Occupancy List
TGTLIST	-	Constructs Target List
INITACQ	-	Initializes Acquisition Devices
CODE18	-	Locates Targets in Hex Tree

d. Lexical Analyzer

LRKPRS	-	LR(K) Parser
RDCELL	-	Split Out Fields in Read State
NXTSYM	-	Get Next Symbol
LEXAN	-	Lexical Analyzer
CHRGEN	-	Character Generator
ADDCHR	-	Add Character to a String
LOOKUP	-	Lookup String in a Table
EXTSCN	-	Process Real and Integer Numbers
ERROR	-	Parser Error Recovery
APCEL 1	-	Split out fields of apply state 1
APCEL 2	-	Split Out Fields of Apply State 2
LACELL	-	Split Out Fields of Look-Ahead State
CARD	-	Read Card/Print Card

e. <u>Red Threat Planning</u>

PLAN	-	Controls Red Threat Planning
THTRPLN	-	Red Theater Planner
CORBOUN	-	Creates Corridor Boundary Structures
REVISE	-	Revises Red Force Allocations
ABVSCOR	-	Matches Airbases with Corridors
CLOSCOR	-	Finds Closest Corridor to an Airbase
CANDTGT	-	Considers Candidate Targets
JGESUIT	-	Determines Geographic Sutiability of Targets
FORMTGT	-	Assigns Formations to Targets
TGTGONE	-	Changes Target Stands to Now-Available
AVAILBL	-	Changes Target Status to Available
SCHEDUL	-	Controls Flight Scheduling
RENDEVU	-	Calculates Formation Rendevous Points
ACFRAG	-	Sets-Up Flight Frag's
CRFLTML	-	Creates Flight Data Structures
FLTGEOM	-	Determines Flight Mission Geometry
PLANOUT	-	Outputs Results of Planning Process
RLRAID	-	Releases Raidblok Structures
RLWAVE	-	Releases Wave Structures
RLTGTYP	-	Releases Target Type Structures
RLFMAKT	-	Releases formation Structures
RLCORD	-	Releases Corridor Structures
RLABDB	-	Releases Airbase Structures

f. <u>Common Utilities</u>

ADDBLOK	-	Adds a Data Block to the Top of a Linked List
CREATE	-	Creates Unit SB and C2 Data Structures
DROPBLOK	-	Drops a Block from a Singly Linked List
FINDBLOK	-	Finds a Block on a Singly Linked List
GETHEX	-	Finds or Creates a Hex Block
GIMME	-	Allocates Storage Space
HEXADD	-	Adds To Hex Numbers
HEXCHZ	-	Chooses Next Hex for a Flight to move to

HEXDIST	-	Calculates Distance Between Two Hexes
HEXINV	-	Calculates Inverse of a Hex Number
HEXMULT	-	Hex Multiplication by a Single Digit
HISTORY	-	Records an Event for Prost Processing
HXDGTS	-	Places a Hex Number in the IDIGITS Array
LINEX	-	Determines Intersection of Two Lines
LNPLOT	-	Prints a Line on the Output File
MESAGE	-	Prints a Message on the Output File
OPTPTH	-	Finds Shortest Path Between Two Hexes
PAGE	-	Advances Page of Output
PELADD	-	Adds Target Blocks to the Potential Target Tree
PTREE	-	Extracts a Block From the Target Tree
PTRMRG	-	Sorts Target Tree
RELEASE	-	Releases Storage Space
RELIST	-	Subdivides Large Released Blocks
RITEI	-	Prints an Integer Value
RITEP	-	Prints a Pointer Value (octal)
RITER	-	Prints a Real Value
THH2PS	-	Translates Hex to Point Slope
THX2XY	-	Translates Hex to X,Y Coordinates
TLL2HX	-	Translates Lat-Long To Hex
TXY2HXL	-	Translates X,Y to Hex at Specified Level
PACK	-	Packs Two Halfword Fields (non-midas)
VNPACK	-	Unpacks Two Halfword Fields (non-midas)
NOWUCIT	-	Hex Peeper List Update
GETPIRS	-	Pointer Retrieval
KOMPARE	-	Compares Two Packed Words and Stores a New Value in the Specified Field.

g. Block Data Routines

BDALT	-	Semantic Processing
BDLEX	-	Semantic Processing
BDLRK	-	Semantic Processing

BDPARS	-	Semantic Processing
BLKDAT	-	Initialization

3. Main Processor Functions And Subroutines

The following lists summarize the functions carried out by various main processor subroutines. For a complete calling hierarchy and detailed subroutine documentation see Appendices I and J and the Source Code. Although They are not repeated in this section, all of the Red Threat planning functions and Subroutines found in the preprocessor are also resident in the main processor.

a. Top Level Control Routines

MADEM	-	Main Routine
FETCH	-	Reads Hold Files
CONTROL	-	Event Control
SELECT	-	Selects Appropriate Event Module
ASSIGN	-	Controls CRC Assisgment of Interceptions
ATTACK	-	Control Red Flight Ground Attacks
COMMO	-	Controls Communications
DOGFITE	-	Controls Air to Air Combat
ENGAGE	-	Controls Surface to Air Engagement
FLY	-	Controls Aircraft Movement
NAYBOR	-	Controls Determination of Unit Proximity
PERCEPT	-	Controls Perception of other Units
PLAN	-	Controls Red Threat Planning
PONDER	-	Controls Unit Information Processing
TOWER	-	Controls Airbase Operations
UMPIRE	-	Controls Simultaneous Event Processing

b. CRC Assignment Of Interceptions To Red Flights

ASSIGN	-	Controls CRC Assignments of Red Flights
INTASIN	-	CRC Attempts Interceptor Assignment
TGTHEX	-	Calculates Interception Point for Two Flights
BTNASIN	-	CRC Attempts BOC Assignment

c. Red Flight Group Attack Process

ATTACK	-	Controls Red Flight Ground Attacks
SHRKILL	-	Shorad Engaged Flights
DESTROY	-	Actions Carried Out When Unit is Destroyed
TERMACQ	-	Terminates Acquisition Devices and Peeper list
KILFLIT	-	Actions Carried Out Flight Dies
FLTWYPE	-	Wipes Out Flight Action Order List
SAMWYPE	-	Actions Carried Out When A Sam Unit Dies
BYENOPS	-	Battery End Of Flight-Pass Up Procedures
SEEKP	-	Seek a Track in Perceptions List
CRCLOSS	-	CRC Actions On Loss Of Target Condition
BNLALLE	-	BOC Ponders Loss of All Engagement Possibilities
HANDZPT	-	Handles Zero Priority Tracks in Adil
BATCEAS	-	Battery Decisions To Cease Engagement
CANCALO	-	Cancel Allocations
READIL	-	Return Track to Adil
RELOCAT	-	Reposition Entry in Doubly Linked List
SEEKTFV	-	Seek New Engagement For a Fire Unit
TRKCHEK	-	Air Defense Unit Ponders Trackability of TGT.
TOADIL	-	Refills Adil
ALLOFU	-	Allocate Fire Unit Against Red Flight
ALLOPAT	-	Allocate Patriot Against Red Flight
DILOUT	-	Eliminate Oil Entry
CNACTIK	-	Cancel Pending Actions for Track
CRCDIES	-	Actions Carried Out When CRC Dies
NUKBLND	-	Commo Block Out Of Units Near Nuke Blast

d. Communications

COMMO	-	Controls Communications Processes

e. Air To Air Combat

DOGFITE	-	Controls Air-To-Air Combat Processes
DESTROY	-	Actions Taken When Unit is Destroyed

f. <u>Surface To Air Engagement</u>

ENGAGE	-	Controls Surface-to-Air Engagement
TRYSHOT	-	Determine if a Missle can be Fired
BATCEAS	-	Battery Decision to Cease Engagement
BNLALLE	-	BOC Ponders Loss of all Engagement Possibilities
FIRECHK	-	Fire Missile Operations
AMMOCHK	-	Account for Missiles
BYNOTRO	-	Battery not ready for action
DILOUT	-	Eliminate Oil Entry

g. <u>Aircraft Movement</u>

FLY	-	Controls Aircarft Movement
VOLLOAD	-	Places a Unit on a Hex's Unit Occupancy list
FVELCHK	-	Checks Fuel Level
FLTWYPE	-	Wipeout Flight Action Order List
SKRKILL	-	Shurad Engages Flights
INTRFLY	-	Process Flight Actions at Decision Points
INTRFLY	-	Interceptor Flight Decisions
TGTHEX	-	Calculate Interception Point for Two Aircraft
COMMAND	-	Flights carry out orders
DESTROY	-	Action taken when Unit is Destroying

h. <u>Determination Of Unit Proximity</u>

NAYBOR	-	Controls Determination of Unit Proximity

i. <u>Unit Perception</u>

PERCEPT	-	Controls Unit Perception Process
ABSEE	-	Airbase Perception
CFLYCRC	-	CRC Perceptions Module Control
CRCSEE	-	CRC Message and Event Perception
CRCEVNT	-	CRC Direct Perceptions
DETECT	-	Detection Logic between Two Units
LOSRADR	-	Radar Line of Sight Determination
CRCTRAK	-	CRC Actions on Enemy Detection
CRCKIL	-	CRC Records Death Report

BABMOVE	-	CRC Records Red Flight Movement
TGTHEX	-	Calculate Interception Point for Two Flights
NEWMOVE	-	CRC New Flight Perception Actions
FLYSEE	-	Flight Perception Module Control
ATKASES	-	Air Attack Damage Accessment on Ground Targets
CRCZINT	-	Interceptors Receive Messages from CRC
RONDSEE	-	Flight Perception of Rendevous
GNDLOOK	-	Flight Perception and Attack of Ground Targets
SAMSEE	-	Sam Perceptions Module Control
SAMPRCM	-	Sam Perceives Aircraft Movement
BYTKCHK	-	Battery Tracking Operations
TOADIL	-	Try to Refill Adil
NEWPERC	-	Create Perceptions List Entry
BYPASUP	-	Battery Passes Track up to BOC
BYENOPS	-	Battery End of Flight-Pass Up Procedures
•CRCLOSS	-	CRC Actions on Loss of Target Condition
DROPPOS	-	Battery Considers Drop Possibility
SEEKENG	-	Seek New Engagement
DROPPS2	-	Battery Considers Drop Possibility 2
DLYACT	-	Add Action to Delayed Action Queve
ALLOBAT	-	Allocate BYRY against Red Flight
PRIORITY	-	Calculate Priority of Track
BNLALLE	-	BOC Ponders loss of All Engagement Possibilities

j. Red Threat Planning

See Section (IIF.2)

k. Unit Information Processing

PONDER	-	Controls Unit Information Processing
TFLYCRC	-	CRC/Flight Ponder Module Control
CRCTHNK	-	CRC Decisions on Receipt of Information

CRCKIL	-	CRC Records Death Report
CRCTRAK	-	CRC Actions on Enemy Detection
CRCLOSS	-	CRC Actions on Loss of Target Condition
AB2CRC	-	CRC Interprets Message from Airbase
INT2CRC	-	CRC Interprests Message from Flight
DETECT	-	Detection Logic Between Two Units
BTN2CRL	-	CRC Interprets Message from BOC
AIRTHNK	-	Ponder Decision to go into Air Combat
DOGTHNK	-	Ponder Next Actions After Air to Air Combat
GOTOAB	-	Actions on Return Flights to Airbase
FUELCHK	-	Check Flight Fuel Level
BOCTINK	-	BOC Ponders Situation
BNPONSS	-	BOC Ponders Subordinate Status Message
BNPONBB	-	BOC Ponders BTRY Back In Action
FILERUP	-	Refuel Aircraft
INRANGE	-	Determine Time Period that Target is in Range
AZILIM	-	Inpose Azimuth Limits on Engage Window
INSECT	-	Calculate Intersection with Sector Limits
SETASSN	-	Set Up for Possible ADV. Assignment
PRIORTY	-	Calculate Priority of Track
SEEKENG	-	Seek New Engagement
DLYACT	-	Add Action to Delayed Action Queve
BYUPDAT	-	Update Battery Status
BNNOTRD	-	BOC Not Ready For Action
DILOUT	-	Eliminate DIL Entry
BATTOUT	-	BTRY Decisions to Drop an Enemy Track
BNLALLE	-	BOC Ponders Loss of All Engagement Possibilities
CHKLAST	-	Determine Last Chance for Engagement and Set Priority
DROPPOS	-	BTRY Considers Drop Possibility
COVAPLY	-	Cover Threat Allocation Decisions

SEEKTAC	-	Seek to Assign Coverage
ALLOBAT	-	Allocate BTRY against Red Flight
READIL	-	Return Track to Adil
DECRALO	-	Decrease Allocations
BNPONEP	-	BOC Ponders Engagement Progress
SKSBTRK	-	Seek Reporting Subordinate and Track
BNCMDPR	-	BOC Command Decision Processes
ACCEPT	-	BTRY Accepts Assignments
BYALCOV	-	BTRYs Alter Coverage Level
CANCALO	-	Cancel Allocations
SEEKTFV	-	Seek New Engagement for a Fire Unit
PATDEC	-	Patriot Decrease Coverage on Track
BATTCOV	-	BTRY Decision to Allocate Coverage on Track
TRKCHEK	-	Ponder Trackability of Flight Target
ALLOFV	-	Allocate Fire Unit Against Red Flight
DLYACT	-	Add Action to Delayed Action Queve
BYHEDUP	-	BTRY Handle Engagement Data Update
SEEKP	-	Seek Track in Perceptions List
BNPONFD	-	BOC Ponders Flight Attrition
SDIGEST	-	Sam Process Information
BNNWTRK	-	BOC Handles Newly Visible Track
CHKCOV	-	Check for Coverage
BYNWTRK	-	BTRY Handles Newly Visible Track
PREPAFU	-	Prepare for Allocation of Fire Units
AUTOPRI	-	BTRY Decision of Target Priority
BNCONTC	-	BOC Considers Change in Track
BNCONHD	-	BOC Considers New Heading
BNRECOV	-	BOC Considers Reducing Coverage
BYCONTC	-	BTRY Considers Change in Track
BYCONLS	-	BTRY Considers Loss of Track
BATCEAS	-	BTRY Decision to Cease Engagement
BNPONDA	-	BOC Processes Delayed Actions

BNPONBD	-	BOC Ponders BTRY Death
SAMATON	-	BTRY Autonomous Actions
BTRYTNK	-	BTRY Ponders Situation
BYCMDPR	-	BTRY Command Decision Processes
BYPONTM	-	BTRY Ponders Track Movement
BYPONER	-	BTRY Ponders Engagement Results
PTPONER	-	Patriot Ponders Engagement Results
BYPONFO	-	BTRY Ponders Red Movement
BYPONRL	-	BTRY Ponders Reload
BYPONRS	-	BTRY Ponders Resupply
RESUPLY	-	BTRY Ponders Resupply of Fire Units

l. <u>Airbase Operations</u>

TOWER	-	Controls Airbase Operations
VOLLOAD	-	Places Unit on Hex Unit Occupancy List
INLTACQ	-	Initialize Acquisition Devices
REDEBRF	-	Process Flight After Landing
WIPEOUT	-	Invalidated a Node on Leftist Tree
DESTROY	-	Action When Unit is Destroyed
GOGETEM	-	Launch Interceptor Flights
CRFLTML	-	Create Flight Structures
PTRAND	-	Generate Uniform Random Hex
FLTGEOM	-	Calculate Flight Geometry

m. <u>Simultaineous Event Control</u>

UMPIRE	-	Controls Simultaineous Events
DESTROY	-	Action When Unit is Destroyed
NUKBLND	-	Commo Black out of Units Near NUKE Blast

<u>Common Utilities</u>

ADDBLOK	-	Adds a Data Block to the Top of Linked List
CREATE	-	Create Unit SB and C2 Data Structures
DELADD	-	Discrete Event Tree Adder
DGTSHX	-	Converts a Value to a Hex Number
DROPBLK	-	Drop a Block from a Singly Linked List

FETCH	-	Red in Hold Files
FINDBLK	-	Find a Block in a Singly Linked List
FSDUMP	-	Print Out ISPACE Contents
FSINIT	-	Free Space Control Initialization
GETHEX	-	Find or Create a Hex Data Block
GIMME	-	Allocate Storage Space
HEXADD	-	Adds Two Hex Numbers
HEXCHZ	-	Chooses Next Hex for a Flight to move to
HEXDIST	-	Calculates Distance Between Two Hexes
HEXINV	-	Calculates inverse of a Hex Number
HEXMLT	-	Hex Multiplication
HEXMOVE	-	Hex Movement
HEXMULT	-	Hex Multiplication
HISTORY	-	Records an Event for the Postprocessor
HXDGTS	-	Places a Hex Number in the IDIGTS Array
HXMLT2	-	Hex Multiplication
IJ2HX	-	Converts I,J Coordinates to Hex
JUGGLE	-	Ships Hex Number to Usable Order
UNEX	-	Determines Intersection of Two Lines
LNPLOT	-	Prints a Line on the Output File
LOADPL	-	Loads the Players List
LTREE	-	Merges a Node on the Leftist Tree
LTRMRG	-	Merges a Node on the Leftist Tree
MESAGE	-	Prints a Message on the Output File
PACK	-	Packs Two Halfword Fields (non-midas)
PAGE	-	Adds Target Blocks to the Potential Target Tree
PELADD	-	Adds Target Blocks to the Potential Target Tree
PTREE	-	Extracts a Block from the Target Tree
PTRMRG	-	Sorts Target Tree
RITEI	-	Prints an Integer Value

RITEP	-	Prints a Pointer Value
RITER	-	Prints a Real Value
UNPACK	-	Unpacks Two Halfwords (non-midas)
UNLINK	-	Removes a Dead Unit from the C2 Tree
YANK	-	Removes an Entry from a Doubly Linked List
STICK	-	Inserts an Entry in a Doubly Linked List
NOWUCIT	-	Hex Peeper List Update
GETPTRS	-	Gets Required Pointers
MESBILD	-	Builds a Message Structure
UNSTAT	-	Unpacks an Aircraft Flight Status Board into a Common
STATPAK	-	Repacks an Aircraft Flight Status Board after it has been Updated
SSL	-	Sorts a Singly Linked List
INSERT	-	Inserts an Entry into an Ordered Linked List
RELOCAT	-	Reposition Entry in Doubly Linked List

4. *Postprocessor Functions And Subroutines*

The following list summariezes functions carried out by various postprocessor subroutines. For a complete calling hierarchy and detailed subroutine documentation see Appendices I and J and the Source Code.

(1)	RECORD	-	Main Control Routine
(2)	INDEX	-	Finds Desired Index in a Storage Array
(3)	MESAGE	-	Prints a Message on the Output File
(4)	PAGE	-	Advances Output Page
(5)	RITEI	-	Prints an Integer Value
(6)	RITER	-	Prints a Real Value
(7)	TABOUT	-	Prints Contents of Storage Arrays

CHAPTER III

DATA STRUCTURE DOCUMENTATION

A. INTRODUCTION

MADEN uses a list processing system to store data. Information is stored in the dynamically allocated array ISPACE in a series of data structures. These data structures are composed of blocks linked in a variety of configurations (eg., trees, lists, etc.) by pointers. Each block is made up of a specified number of words. In many cases words are divided into fields which contain descrete pieces of information. The pointers which connect blocks into data structures are actually addresses in the one dimensional army ISPACE. Since the number and configuration of blocks stored in ISPACE changes during model execution, the storage system is said to be dynamic. ISPACE is currently limited to 131,000 words of storage.

Sections B through G of this manual document the common blocks and data structures used by MADEM. Table III-1 provides a cross reference of data block types and the sections of this manual in which they are discussed. Since these blocks are defined and accessed using the Modular Information Data Access System (MIDAS), documentation of MIDAS and the tables used to define the data blocks have been included in Appendices B and D. In addition, Table III-2 provides an outline of the standard data structure documentation format used in this manual.

TABLE III-1. DATA BLOCK DOCUMENTATION CROSS REFERENCE

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQ DEVICE	ACRFT LIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB
C DATA BASE		●			●			●	●			●
D 1 EVENT LISTS												
D 2 HEX TREE												
E 1 PLAYER LISTS												
E 2 C2 TREES												
E 3 PASSIVE TGT												
F 1 RED CMDR												
F 2 POTENTIAL TGTS												
F 3 ASSIGNED TGTS												
F 4 NONAVAIL TGTS												
F 5 CORRIDOR				●						●		
F 6 ATTK REQ										●		
F 7 RED AB	●	●	●		●							
F 8 RED FLT					●							
G 1 ATAF												
G 2 SOC												
G 3 CRC						●	●					
G 4 BLUE AB	●	●	●		●							
G 5 BLUE FLT					●							
G 6 BOC												●
G 7 BTRY												●
G 8 PASSIVE TGT												
H STORAGE												

	ALLOCATE	AQDB	ARCFTSAVV	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND
C DATA BASE		●										
D 1 EVENT LISTS												
D 2 HEX TREE									●			
E 1 PLAYER LISTS										●		
E 2 C2 TREES										●		
E 3 PASSIVE TGT										●		
F 1 RED CMDR										●		
F 2 POTENTIAL TGTS												
F 3 ASSIGNED TGTS				●								
F 4 NONAVAIL TGTS												
F 5 CORRIDOR												
F 6 ATTK REQ				●								●
F 7 RED AB										●		
F 8 RED FLT	●	●	●							●		●
G 1 ATAF										●		
G 2 SOC										●		
G 3 CRC		●								●		
G 4 BLUE AB										●		
G 5 BLUE FLT		●	●	●						●		●
G 6 BOC						●				●		
G 7 BTRY	●						●	●		●		
G 8 PASSIVE TGT										●		
H STORAGE												

	CONST BLOK	CORRIDOR BLOK	CRCSEE BLUE	CRCSEE RED	CRCSEES	CRCSUBORD	DAQE	DAT BLOK	DAT BUF	DBCLASS BLOK	DIB
C DATA BASE								●	●		
D 1 EVENT LISTS											
D 2 HEX TREE											
E 1 PLAYER LISTS											
E 2 C2 TREES											
E 3 PASSIVE TGT											
F 1 RED CMDR											
F 2 POTENTIAL TGTS											
F 3 ASSIGNED TGTS											
F 4 NONAVAIL TGTS											
F 5 CORRIDOR	●	●									
F 6 ATTK REQ											
F 7 RED AB											
F 8 RED FLT											
G 1 ATAF											
G 2 SOC											
G 3 CRC			●	●	●	●					
G 4 BLUE AB											
G 5 BLUE FLT											
G 6 BOC											●
G 7 BTRY											●
G 8 PASSIVE TGT											
H STORAGE											

4368/79W

TABLE III-1. DATA BLOCK DOCUMENTATION CROSS REFERENCE (CONTINUED)

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYE BALL	FAKTG BLOK	FDBD BLOK	FIRE UNIT	FLTAKT BLOK	FLTDB	FMFLTDB	FOREST	FORMATION	FORMATION BLOK	FORTGTBUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDOBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
C DATA BASE							●			●	●																		●	●	●				
D 1 EVENT LISTS				●																	●			●											
D 2 HEX TREE																	●		●			●													
E 1 PLAYER LISTS																																	●		●
E 2 C2 TREES																																		●	
E 3 PASSIVE TGT																																			
F 1 RED CMDR																																			
F 2 POTENTIAL TGTS												●			●																				
F 3 ASSIGNED TGTS																																			
F 4 NONAVAIL TGTS																										●									
F 5 CORRIDOR																		●		●															
F 6 ATTK REQ						●	●		●		●			●																					
F 7 RED AB																																			
F 8 RED FLT										●			●										●		●		●			●	●				
G 1 ATAF																																			
G 2 SOC																																			
G 3 CRC																																			
G 4 BLUE AB																																			
G 5 BLUE FLT										●			●										●		●		●			●	●				
G 6 BOC	●																											●				●			
G 7 BTRY			●					●																								●			
G 8 PASSIVE TGT																																			
H STORAGE																																			

4368/79W

TABLE III-1. DATA BLOCK DOCUMENTATION CROSS REFERENCE (CONTINUED)

	PROFILED BLOK	PR BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STD BLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGTPTREE	TTD BLOK	WAVE BLOK	WINGMAN	GARBAGE LIST BLOCKS
C. DATA BASE	●																						
D.1 EVENT LISTS																							
D.2 HEX TREE																							
E.1 PLAYER LISTS																							
E.2 C2 TREES							●	●															
E.3 PASSIVE TGT							●																
F.1 RED CMDR					●		●	●				●						●		●	●		
F.2 POTENTIAL TGTS												●							●				
F.3 ASSIGNED TGTS								●				●						●		●			
F.4 NONAVAIL TGTS												●											
F.5 CORRIDOR																							
F.6 ATTK REQ																							
F.7 RED AB			●	●			●																
F.8 RED FLT							●	●	●													●	
G.1 ATAF							●	●															
G.2 SOC							●	●															
G.3 CRC							●	●		●			●		●								
G.4 BLUE AB							●																
G.5 BLUE FLT							●	●	●													●	
G.6 BOC							●	●			●			●									
G.7 BTRY							●	●															
G.8 PASSIVE TGT							●																
H. STORAGE																							●

4368/79W

TABLE III-2. STANDARD DATA STRUCTURE DOCUMENTATION FORMAT

* <u>SECTION HEADING</u>

A. <u>DATA BLOCK INDEX</u>
A list of MIDAS data blocks discussed in the section.

B. <u>DESCRIPTION</u>
A general description of the data structure and its purpose in MADEM. This description refers to the diagrams in subsections C and D. Other diagrams which show what the structure is attempting to represent in the real world (ex: 4 C2 hierarchy) are also included if they are helpful to an understanding of the structure.

C. <u>STRUCTURE OVERVIEW</u>
This subsection is intended to give the user a general view of the structure and its' component blocks.
1) <u>STRUCTURE DIAGRAM</u>
A diagram of the entire structure showing the overall configuration of data blocks.
2) <u>BLOCK DEFINITIONS</u>
Short definitions of all data blocks in the structure.

D. <u>BLOCK SPECIFICATIONS</u>
This subsection is intended to give the user a detailed view of the data blocks in the structure and the exact definition of variables in each field.
1) <u>BLOCK DIAGRAMS</u>
Detailed diagrams of all data blocks including field names.
2) <u>FIELD DEFINITIONS</u>
Precise definitions for all fields in all blocks. These definitions are sub-divided by block and contain all relevant values.

E. <u>LINKAGES TO OTHER DATA STRUCTURES</u>
Linkages to other data structures are noted along with the purpose of the linkages.

F. <u>NOTES</u>
Any notes or questions relating to the data structure and its' contents.

B. COMMON BLOCKS

(1)	COMMON/AAPK/	-	air-to-Air PK Common
	AAPK	-	antiaircraft probability of kill
(2)	COMMON/ACFRAG/	-	AIRCRAFT FLIGHT Plan Common
	NSECTOR	-	Corridor Zone Number
	PTGTHEX	-	
	PADRCG	-	
	PHEXENT	-	
	TATREND	-	
	PHEXEXT	-	
(3)	COMMON/AFM/	-	Debugging common for ?TRACE? JINX -
(4)	COMMON/AGPD/	-	Air to Ground Probability of Detection AGPD -
(5)	COMMON/AGPK/	-	Air to Ground Probability of kill AGPK -
(6)	COMMON/CLOOK/	-	Common for dumping COMMONS
	ISTABL	-	
	NRSRV	-	
	ISTAB	-	
(7)	COMMON/COMOUT/	-	
	LBL	-	
	LBLCT	-	
(8)	COMMON/COMPTR/	-	
	PHXTOP	-	pointer to top of address tree
	PTRBLUE	-	pointer to top of blue C2 tree
	PTRRED	-	pointer to top of red C2 tree
	PBLTGT	-	pointer to top of list of red targets
	PTRC2	-	pointer to active C2 tree
	PBLUPL	-	pointer to blue players list
	PREDPL	-	pointer to red players list
	PTRPL	-	pointer to active players list
	PLASTC	-	C2 pointer of last mentioned commander
	PLASTS	-	C2 pointer of last mentioned subordinate
	LSIDE	-	Active side (1 = Blue, 2 = red)

LHEX	-	last hex mentioned
PTRCDB	-	last mentioned corridor description pointer
PTRWDB	-	last mentioned wave description pointer
PTRRDB	-	last mentioned raid description pointer
PTRTTDB	-	last mentioned target type description pointer
BUFZN	-	buffer zone width value
IGMSRT	-	game hour start time, default = 1
IDYSRT	-	game day start time, default = 1
PTRDATA	-	pointer to data base
PTOPORD	-	pointer to red orders
PREDSEE	-	pointer to red commanders perception list
ISIZE	-	size of player list array, equal to maximum number of players on largest side

(9) COMMON/COMSCS/ -

LMASK	-	bit mask for left hand side of a ward
RMASK	-	bit mask for right hand side of a ward
INITCEL	-	initialize the cell (currently not used)
TREETOP	-	top of the discrete event list
ENDTIME	-	end of the game
INCTIME	-	increment of time for interim output
GTIME	-	game of current discrete event
CELMINT	-	increment time for cell event
LPTR	-	array of pointers to cell events

(10) COMMON/CRCCOM/ -

IEVENT	-	CRC's current event
PSB	-	pointer to the scoreboard
PADR	-	pointer to hex address
ITYPE	-	unit type
ISIDE	-	multiple definitions

(11) COMMON/CSTK/ - Language Processor

IPSTK	-	stack used by language processor
L	-	
LLMAX	-	
NSTK	-	

(12) COMMON/DATA/ -

PTRDAT -

(13) COMMON/DEBUG/

DBGA -

DBGB -

DBG -

DBGD -

(14) COMMON/DFLAGS/ -

IDEBUG - a flag which turns on ENTRYP and EXITP. If equal to 2HON turns on entry and exit messages for all routines

IDUMP - ISPACE dumping option flag, set as a parameter in MADEM if set equal to 2HON, ISPACE will be dumped

IDATFLG - DATFILE display flag, set as input parameter in MADEM ZHON - will display DATFILE data data structure only in INITBIN

ISTOP - input parameter set in MADEM

- if equal to 4HODAT stops after UOIL (can be used to get ISPACE dump before players list is released)

- if equal 3HDEL stops INITBIN after DELADD and before CONTROL

(15) COMMON/XTRACE -

ITRPTR - Pointer to circular list

TRACIR - circular list of last 50 routine entries

TRAPTR - pointer to routine pushdown stack

TRAPDS - push down stack of routine entries

ICOUNT - vector of routine entry counts

(16) COMMON/STEXT/ -

SEGTXT - vector of routine names in hollerith

(17) COMMON/FS/ -

- PTRFS - pointer to first ward of free space
- PTRRSL - pointer to recovered storage list
- MXSPCE - maximum length of ISPACE, set in MADEM
- ID - last Assigned Player ID Number

(18) COMMON/HALT/ -

- IFSTOP - a flag, if equal to 1, MADEM stops in control
- CPULIM - maximum number of CPU second set in MADEM
- CELTIME -
- LEVEL -

(19) COMMON/INITPTR/- All major values from Player SB.SDB

- PTRADR - PTR to current address
- PPTRC2 - PTR to C2 node
- PTRSDB - pointer to status display board
- PTRFEL - pointer to future event list
- PTRACQ - pointer to ACQDEVICE block
- PTRCOM - pointer to command block
- PTRSTAT - Pointer to a unit status block
- PTRSEE - pointer to perceptions list
- PTRSUB - pointer to a subordinate block
- PTRORD - pointer to orders block
- MYTYPE - Player unit type
- MYSIDE - player side

(20) COMMON/IODEV/ -

- IN - device number of input file
- NUOIL - device number of UOIL file
- ND - device number of DATFILE

(21) COMMON/JJOPT/ -

- IOP - start or restart option flag
  - if equal to 1 start at beginning (INITBIN)
  - if equal to 2 restart (RUNBIN)

(22)	COMMON/LIMITS/	-	Max & Min limits on ISPACE
	LOWER	-	Extend core location of ISPACE (1)
	LUPPER	-	extended core location of last work of ISPACE
(23)	COMMON/MASK/	-	
	IL	-	masking constant = 77777777770000000000B
	ILM	-	masking constant = 10000000000B
(24)	COMMON/MODVAR/	-	
	INCDNT	-	incident code (event code)
	NEHMEN	-	receiver of the event
	LASSEN	-	schedules of an event
	TIME	-	game time of tne scheduled event
	MSG	-	Pointer to the message block
	PTRGOD	-	PTR to a god like creature whose omnipitence awes all who meet
	RSEED	-	random seed
(25)	COMMON/MXMIS/	-	
	MXSUP	-	
(26)	COMMON/PATH/	-	
	LASTP	-	
	LREP	-	
	LASTR	-	
(27)	COMMON/SAMPK/	-	
	SAMPKA	-	SAM probability of kill
	SAMPKB	-	SAM probability of kill
(28)	COMMON/SAMPTRS/	-	
	PMYDATA	-	pointer to data base associated with considered unit
	PDIL	-	pointer to element in digested information list which corresponds to a particular considered flight

PPPINFOR	-	pointer to considered perception list entry for battery or BOC
PDINFO	-	pointer to considered digested information block for battery or BOC
POINFO	-	pointer to old digested information block for battery or BOC
PBAT	-	pointer to SUBLIST block representing a particular subordinate BOC
PPAL	-	pointer to PAL entry for track
PFU	-	pointer to fire unit block

(29) COMMON/SEMINFO/-

IVALUE	-	an array which holds real number from the SEMANT sentences
IFLAG	-	

(30) COMMON/SPACE/ -

BLANK	-	required!
ISPACE	-	

(31) COMMON/SPSTAT/ -

ICIGIM	-	counts the number of blocks by block size that GIMME allocates
ICTREL	-	counts the number of blocks by block size that are released by RELEASE

(32) COMMON/STATBD/ - AIRCRAFT STATUS Board

PFLTTYP	-	pointer to Flight DATA BASE
PTRMUN	-	pointer to MUNITIONS list
PTRSTRT	-	pointer to start hex of leg
PTREND	-	pointer to end hex of leg
PTRNXT	-	pointer to next hex in flight path
PTRAB	-	pointer to SB of home AB
NUMTGT	-	number of aircraft in air-to-air track

PTGTSB	-	pointer to air-to-air target SB
PGNDTGT	-	pointer to air-to-ground target SB
NUMAC	-	number of aircraft in flight
LEGSTA	-	type of leg currently being blown
INSTA	-	status of interceptor
ITALTCNG	-	climbing, diving level
NDXPROF	-	index into flight profile list
LNDSTA	-	landing status
IORBSTA	-	orbit status
IAIRCOM	-	air-to-air combat status
IGNDATK	-	air-to-ground combat status
JAMSTA	-	jammer status
FUEL	-	current fuel in of hexes
ALTUDE	-	current altitude
SPEED	-	current speed
DIRECT	-	current heading

(33) COMMON/THTRPLN/-

PFOREST	-	pointer to target list
PNOAVAL	-	pointer to non available target list

(34) COMMON/TRACK/ -

PFADR	-	
ISID	-	

(35) COMMON/TYPES/ -

IARRAY	-	

(36) COMMON/OUTDEV/ -

OUTDEV	-	output device for data structure displays

C. DATA BASE STRUCTURE - DATFILE

1. Data Block Index

ACDB
ABQUEDB
ACRFTLIST
ACRFTONAB
ADSITEDB
AQDB
DATBLOK
DATBUF
FDBDBLOK
FLTDB
FMFLTDB
PAYBUF
PAYLOAD
PAYLDBLOK
PROFILEDBLOK

2. Description

The DATFILE data structure, built by subroutine OTHRDAT, contains only data from the MADEM input file 'DATFILE'. The DATFILE data is divided into 13 classes. Nine of these classes (classes 6026, 6001-6008) are stored in the DATFILE data structure. The other four classes are in common blocks.

The DATFILE data structure is a matrix of linked lists that includes 15 distinct data blocks. Fourteen of those data blocks point to themselves and thus are singly linked lists. The only block that is not part of a linked list is the one word buffer (DATBUF) at the top of the DATFILE structure.

The main linked list in DATFILE consists of nine occurrences of DATBLOK. Each occurrence is a two-word buffer block for one of the nine classes of DATFILE data that are stored in DATFILE. Each two-word buffer points to a data block specific that class (6000 SERIES). Some of those data blocks point to even more linked lists. See the diagrams for a better picture of DATFILE.

3. Structure Overview

a. Structure Diagram (See Figure III-1)

b. Block Definitions

DATBUF	Data Base Buffer Block. Top of entire (DAFILE) structure. Pointed to by PTRDATA in common COMPTR.
DATBLOK	Data Class Block. Top of DATBLOK list pointed to by DATBUE block. One DATBLOK block for each data class (6000 SERIES).
ADSITEDB (Class-6026)	Air Defense Site Data Base Block. Used to describe BOC and Battery characteristics. One block for each type of BOC and Battery (e.g., HAWK, HERC, PATRIOT).
EDBDBLOK (Class-6001)	Formation Data Base Block. Formation description. One block for each formation type.
FMFLTDB (Class-6001)	Formations Flight Data Base Block. Describes flights in the formation referred to in the EDDBDBLOK blocks.
FLTDB (Class-6002)	Flight Data Base Block. Contains basic flight characteristics. One block for each flight.
PAYLOAD (Class-6002)	Payload Data Base Block. Contains basic information on payload capacity and range.
ACDR (Class-6003)	Aircraft Data Base Block. Contains basic aircraft characteristics. One block for each aircraft type, Red and Blue.
PAYBUF (Class-6004)	Payload Type Buffer Block. Buffer block for PAYLDDBLOK blocks. One block for each payload type.
PAYLDDBLOK (Class-6004)	Payload Identification Block. Contains specific payload/weapon code. Represents a particular weapon of a given type.

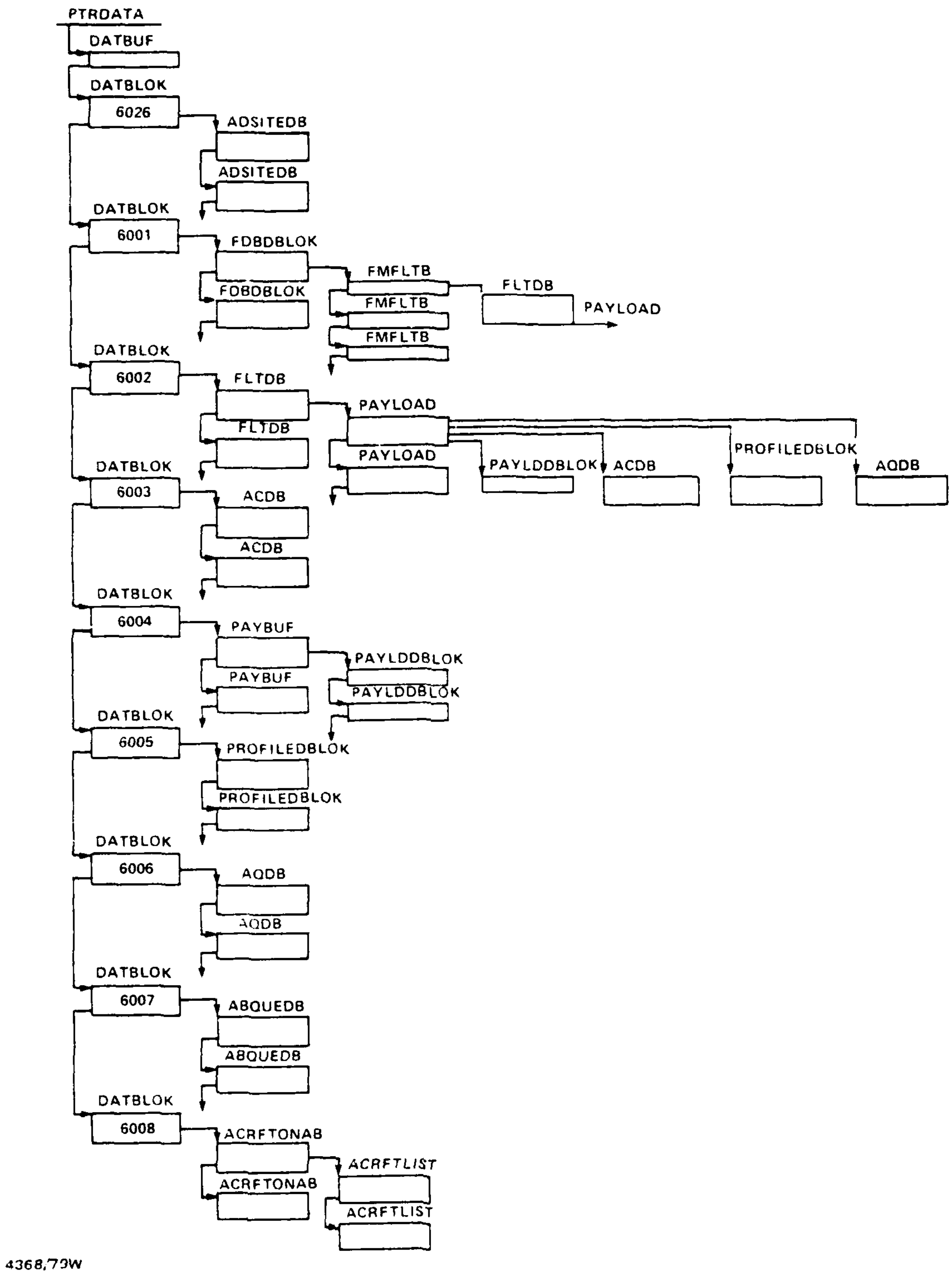

Figure III-1. Data Base Structure Diagram

PROFILEDBLOK (Class-6005)	Profile Specification Block. Describes basic mission profile in terms of altitude on various legs of the mission.
AQDB (Class-6006)	Acquisition Data Base Block. Specifies acquisition range for a given device.
ABQUEDB (Class-6007)	Air Base Queue Data Base Block. Service queue information for air bases. One for each air base.
ACRFTONAB (Class-6008)	Initial Aircraft on Air Base Block. Specifies number of aircraft types on an air base. One for each air base, Red and Blue.
ACRFTLIST (Class-6002)	Aircraft List Block. One for each aircraft type. Pointed to by ACRFTONAB. Contains aircraft type code.

4. *Block Specifications*

   a. Block Diagrams

      1) DATBUF

PDATBLK	NUMBLOK

      2) DATBLOK

PNEXT	CLASS

3) ADSITEDB

PNEXT	ADTYPE
MODVAL1	MAXNUMDIGEST
MAXTIMEDIGEST	MINTIMEDIGEST
LOSTIME (SPACE)	
LASTCHANCE (SPACE)	
ENGAGEWINDOW(SPACE)	
MODVAL2 (SPACE)	
MODVAL3 (SPACE)	
COVONONE	ONE
COVONFEW	FEW
COVONMANY	MANY
TIMEFLIGHT(SPACE)	
MISSILERANGE(SPACE)	
MAXASSIGN	MODVAL4
MODVAL5(SPACE)	
MAXTRACTRANGE(SPACE)	
LOCKONTIME(SPACE)	
MODVAL6(SPACE)	
MODVAL7(SPACE)	
CONVLOAD	
SNUKELOAD	LNUDELOAD
RESUPPLYCV	CVRESUPPLYFREQ
RESUPPLYSN	SNRESUPPLYFREQ
RESUPPLYSN	LNRESUPPLYFREQ

4) FDBDBLOK

PNEXT	NRFORM
PTRFLT	NOFLTL=3
SPFORMC	

5) FMFLTDB

PNEXT	PNXFLDB

6) FLTDB

PNXFLDB	NRFLITE
PTYPLDS	NOPYLDS
PTYAQDB	PTACDB
MAXNOAC	MINNOAC
MULTAC	PROFILE
SPFLTC(SPACE)	
DISTSEP(SPACE)	

7) PAYLOAD

PNXTYPD	NRPDCLS
MAXAMT	MINAMT
MAXFIRERANGE	PAYLDDB

8) ACDB

NEXT	NRACTYPE
MAXSPEED(SPACE)	
CRUISESPEED(SPACE	
MAXALTITUDE(SPACE)	
MINALTITUDE(SPACE)	
MAXCLIMBDIVE(SPACE)	
FUELCONSUME(SPACE)	
ACQRANGE(SPACE)	
RADARCS(SPACE)	
ATTACKRADIUS(SPACE)	
MAXFUEL(SPACE)	

9) PAYBUF

PNEXT	NRPDCLS
PAYLDDB	NUMBLOK

10) PAYLDDBLOK

NEXT	TYPEINDEX

11) PROFILEDBLOK

PNXPRDB	NRPROFL
ALTCREW(SPACE)	
ALTOTGT(SPACE)	
ALTDAB(SPACE)	

12) AQDB

NEXT	NRAQTYP
RANGE(SPACE)	
NOUSE1	
NOUSE2	

13) ABQUEDB

PNEXT	CLASS
VALUE1(SPACE)	
VALUE2(SPACE)	
VALUE3(SPACE)	

14) ACRFTONAB

PNEXT	ABID
ACRFTLIST	NUMBLOKS

15) ACRFTLIST

PNEXT	ACRFTID
NUMACRFT	
FORMTYPE	

b. Field Definitions

1) DATBUF Block

PDATBLK	Pointer to first DATBLOK block.
NUMBLOK	Number of DATBLOK blocks in list.

2) DATBLOK Block

PNEXT	Pointer to next DATBLOK block.
CLASS	DATFILE class (6000 SERIES).
	6026 = Air defense site data
	6001 = Formation specifications
	6002 = Flight specifications
	6003 = Aircraft specifications
	6004 = Payload specifications
	6005 = Flight profile specifications
	6006 = Acquisition device data
	6007 = Air base queue data
	6008 = Initial aircraft types on air bases

PCLASS	Pointer to first data block for the class. The actual data block varies from class to class.
NUMBLOK	Number of data blocks in list pointed to by PCLA.

3) <u>ADSITEDB Block</u>

PNEXT: Pointer to next ADSITEDB block.

ADTYPE: Unit type of this unit, must be a BOC or BTRY.

MODVAL1:	Model Value = 1
MAXNUMDIGEST:	Maximum number of flights on which a BOC or BTRY can be digesting info at one time.
MAXTIME DIGEST:	Maximum time (in seconds) between consecutive digests of info (BOC & BTRY).
MINTIME DIGEST:	Minimum time (in seconds) between consecutive digests of info (BOC & BTRY).
LOSTTIME:	Time (in seconds) after which a track not seen is assumed permanently lost (BOC & BTRY).
LASTCHANCE:	Time (in seconds) considered short for a subordinate to respond to a target. (Time from now until his last chance to shoot.) BOC only, for BTRY = 0.
ENGAGEWINDOW:	Minimum length of subordinates engagement window for a significant engagement opportunity in seconds (BOC & BTRY).
MODVAL2:	Model value = 0
MODVAL3:	Model value = 0
COVONONE:	Desired number of fire units coverage for one aircraft (BOC & BTRY).

ONE:	Model value = 1
COVONFEW:	Desired number of fire units coverage for few aircraft (BOC & BTRY).
FEW:	Model value = 5, number of aircraft considered "few."
COVONMANY:	Desired number of fire units coverage for many aircraft (BOC & BTRY).
MANY:	Model value = 1000000.
TIMEFLIGHT:	Maximum time (in seconds of flight for missile (BOC & BTRY).
MISSILERANGE:	Maximum range for missiles in meters (BOC & BTRY).
MAXASSIGN:	Maximum number of targets per ready fire unit to be assigned at one time. BOC only, BTRY = 0.
MODVAL4:	Model value; for BOC = 8, for BTRY = 11.
MODVAL5:	Model value 0.
MAXTRACKRANGE:	Maximum tracking range in meters. BTRY only, BOC = 0.
LOCK ON TIME:	Assumed time (in seconds) for BTRY to achieve lockon. BTRY only, BOC = 0.
MODVAL6:	Model value = 0.
MODVAL7:	Model value = 0.
CONVLOAD:	Number of Conventional missiles.
SNUKELOAD:	Number of large nukes.
LNUKELOAD:	Number of large nukes.
RESUPPLYCV:	Number of missiles per resupply of ammo. BTRY only, BOC = 0.
CVRESUPPLYFREQ:	Time (in seconds) between resupply of conventional ammo. BTRY only, BOC = 0.

RESUPPLYSN:	Number of missiles per resupply of small nukes. BTRY only, BOC = 0.
RESUPPLYLN:	Number of missiles per resupply of large nukes. (BTRY only, BOC = 0.)
LNRESUPPLYFREQ:	Time (in seconds) between resupply of large nukes. BTRY only, BOC = 0.

4). ADSITEDB Block

PNEXT:	Pointer to next FDBDBLOK.
NRFORM:	Formation number, must be unique.
PTRFLT:	Pointer to formations flight block (FMFLTDB).
NOFLTL:	Number of flights in the formation.
SPFORMC:	Formation cruise speed in meters/ seconds.

5) FMFLTOB Block

PNEXT:	Pointer to next formation flight block.
PNXFLDB:	Pointer to flight data block (FLTDB).

6) FLTDB Block

PNXFLDB:	Pointer to next FLTDB Clock.
NRFLITE:	Unique flight specification number.
PTYPLDS:	Pointer to payload data block (Payload Class 6002).
NOPYLDS:	Number of payload data blocks.
PTYAQDB:	Pointer to acquisition data block (AQDB, Class 6007).
PTACDB:	Pointer to Aircraft Specification data block (ACDB, Class 6003).
MAXNOAC:	Maximum number of aircraft in flight.
MINNOAC:	Minimum number of aircraft in flight.
MULTAC:	Multiples of aircraft required for flight.
PROFILE:	Pointer to profile specification data block (PROFILEDBLOK, Class 6005).

	SPFLTC:	Flight cruising speed in meters/seconds.
	DISTSEP:	Flight separation distance in meters.
7)	<u>PAYLOAD Block</u>	
	PNXTYPD:	Pointer to next payload block.
	NRPDCLS:	Payload type, must be 3 or 4: 3 = air to ground 4 = air to air
	MAXAMT:	Maximum number of loads of this payload.
	MINAMT:	Minimum number of loads of this payload.
	MAXFIRERANGE:	Future use by an enhancement for maximum fire range for engagements greater than one hex.
	PAYLDDB:	Pointer to payload ID DATA BLOCK (PAYLDDBLOK, Class 6004).
8)	<u>ACDB Block</u>	
	NEXT:	Pointer to next ACDB block.
	NRACTYPE:	Aircraft type number.
	MAXSPEED:	Maximum speed in meters/seconds.
	CRUISESPEED:	Cruising speed in meters/seconds.
	MAXALTITUDE:	Maximum altitude in meters.
	MINALTITUDE:	Minimum altitude in meters.
	MAXCLIMBDIVE:	Maximum climb/dive rate in meters/seconds.
	FUELCONSUME:	Fuel consumption rate in hexes/seconds.
	ACQRANGE:	Acquisition range in meters.
	RDRARCS:	Radar cross section in hexes.
	ATTACKRADIUS:	Attack radius in meters.
	MAXFUEL:	Maximum fuel load in hexes.
9)	<u>PAYBUF Block</u>	
	PNEXT:	Pointer to next PAYBUF.

NRPDCLS:	Type of payload, must be 3 or 4: 3 = Air to ground 4 = Air to air
PAYLDDB:	Pointer to ID Blocks (PAYLDDBLOK, Class 6004) for this payload type. Number of ID Blocks for this payload type.

10) <u>PAYLDDBLOK Block</u>

NEXT:	Pointer to next ID block.
TYPEINDEX:	Payload ID, unique within each payload type.

11) <u>PROFILEDBLOK Block</u>

PNXPRDB:	Pointer to next PROFILEDBLOK.
NRPROFL:	Profile Identification number, must be unique within the 6005 Class.
ALTCREN:	Altitude of first leg in meters.
ALTOTGT:	Altitude of second leg in meters.
ALTOAB:	Altitude of third leg in meters.

12) <u>AQDB Block</u>

NEXT:	Pointer to next AQDB block.
NRAQTYP:	Unit type.
RANGE:	Acquisition range in meters.
NOUSE1:	Not used.
NOUSE2:	Not used.

13) <u>ABQUEDB Block</u>

PNEXT:	Pointer to next ABQUEDB block.
CLASS:	Queue Class, currently model value = 1.
VALUE1:	Model value = 0.005.
VALUE2:	Model value = 0.
VALUE3:	Model value = 0.2.

14) <u>ACRFTONAB Block</u>

PNEXT:	Pointer to next ACRFTONAB block.
ABID:	Air base ID.

ACRFTLIST:	Pointer to aircraft list (ACRFLIST) for this air base.
NUMBLOCKS:	Number of aircraft types on this air base. Limit 1 for Blue.

15) ACRFTLIST Block

PNEXT:	Pointer to next ACRFTLIST block.
ACRFTID:	Type of aircraft (400 Series).
NUMACRFT:	Number of aircraft.
FORMTYPE:	Formation type number. * Required for Blue air bases. * Equals zero for Red air bases.

5. Linkages to Other Data Structures

The DATFILE data structure is self-contained in the sense that none of its member data blocks point to blocks outside the DATFILE structure. The reason for this is that the DATFILE data structure is merely a representation of the input file DATFILE, and thus needs no external pointers.

Other data structures and blocks, however, point to DATFILE as follows:

Block	Points To	Comments
FORMATIONBLOK	FDBDBLOK	To identify each Red formation.
FLTAKTBLOK	FLTDB	Once for each Red flight attacking a target.
ACRFTSTATUS	FLTDB	Once for each Red aircraft to identify its flight.
LOAD	PAYLOAD	To identify an aircraft's payload.
ABINFO	ACDB	Once for each aircraft type. So that an air base has access to aircraft specs.
QUEUES	ABQUEDB	Air base queue data block.

The top of the DATFILE structure (DATBUF) is pointed by by PTRDATA, a variable in common block COMPTR.

6. Notes

Three of DATFILE's blocks--DATBUF, DATBLOK, and PAYBUF--were not in the pre-1979 "full" MIDAS table. As of August 20, 1979, however, plans were to include these blocks in the MIDAS table.

The third word of block PAYLOAD is defined differently in the MIDAS table than it was used in the non-MIDASed OTHRDAT routine. It was a full word pointer to PAYLDDBLOK but has been redefined so that the 2nd half word is that pointer and the first half word is the maximum firing range for PAYLOAD. This was done to allow for a future enhancement.

D. SIMULATION CONTROL STRUCTURES

The simulation control structures are used to control event processing and movement within the hexagonal coordinate system. Event processing structures include the discrete event list and future event lists. Hexagonal coordinate system related structures include the hex address tree, unit occupance lists and peeper lists. These control structures are explained in detail in the following subsections.

1. Event Lists

a. Data Block Index

EVENT

LEFTREE

MESSAGE

b. Description

Event scheduling in MADEM is carried out using the three data block types listed above. These block types are used to build two event control data structures DEL and FEL.

The DISCRETE EVENT LIST (DEL) is the most complex of these structures. It uses all three block types to build a leftist tree of the form shown in the structure diagram under the DEL label. The DEL structure is used to track all scheduled events with the next event to occur placed at the top of the tree. The leftist tree form is used to speed sorting of the large number of events scheduled by the model. For a complete explanation of leftist tree sorting algorithms see Appendix E. It should be noted that the DEL is actually a threaded tree in that the event blocks have pointer fields which allow them to be independently linked into doubly linked lists. This capability is shown in the structure diagram by the dotted lines.

The future event list (FEL) is a doubly linked list formed within the DEL structure using the threading capability described above. The FEL is used to keep track of events scheduled by a particular player. This allows future events (as described by EVENT, LEFTREE, AND MESSAGE blocks) scheduled by a player to be deleted from the DEL with minimal effort if the player is destroyed before these events can occur. An example of a FEL is shown in the structure diagram.

c. Structure Overview

1) Structure Diagram (Figure III-2)

2) Block Definitiions

LEFTREE - LEFTIST EVENT TREE NODE. Contains time of event used for sorting and pointers which connect the node to the rest of the tree.

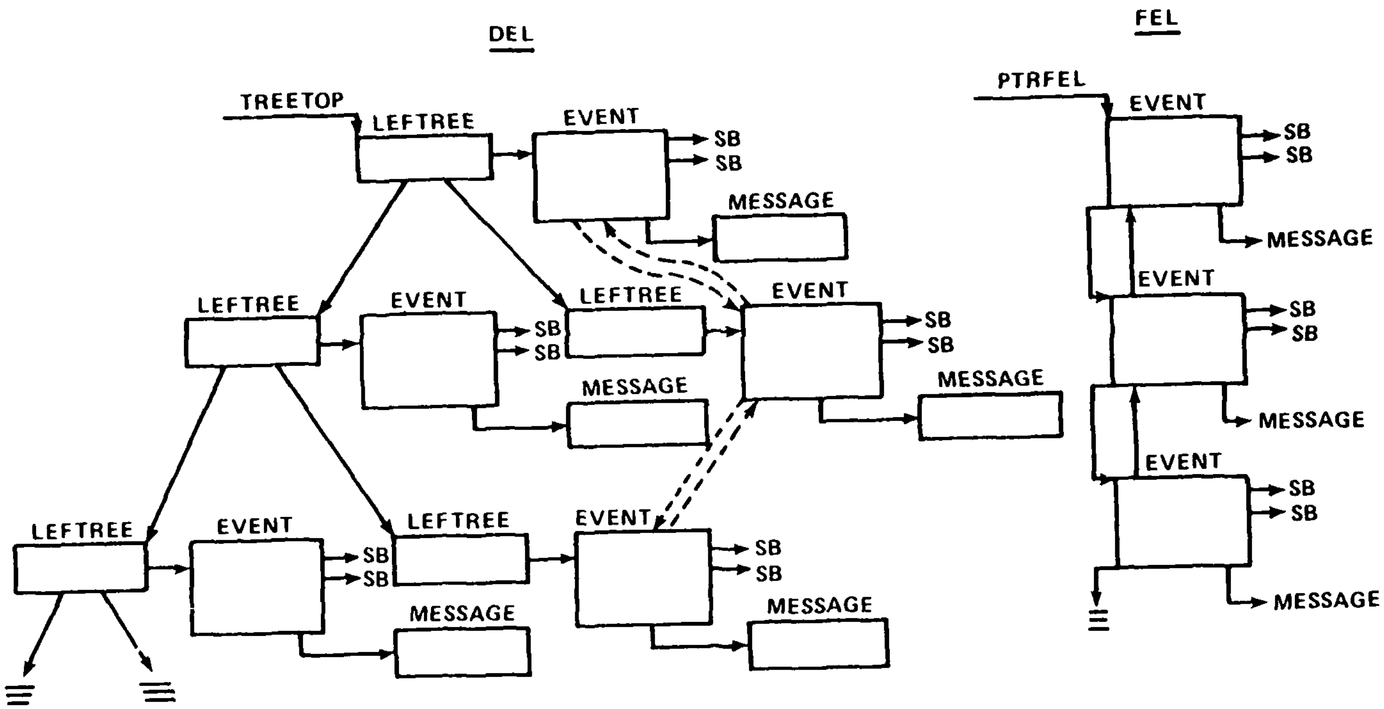

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Figure III-2. Discreet Event List Diagram

EVENT EVENT BLOCK. Contains a description of the event, its time of occurrence, pointers to the SB (Scoreboards) of the perpetrator and victim of an event. MESSAGE. Contains message codes associated with an event.

d. Block Specifications

1. Block Diagrams

a. EVENT

NEHMEN	INCONT
PTRUP	PTRDOWN
MSG	LASSEN TIME (SPACE)

b) LEFTREE

TIME (SPACE)			
PREVENT	DIST	PLEFT	PRITE

c) MESSAGE

PTR	FREQ
VALUE 1	VALUE 2
+ VALUE 3	

Note: + indicates alternate field definition for preceding word.

2. Field Definitions

a) EVENT BLOCK

NEHMAN pointer to the player to be processed in the event. (Points to the player's scoreboard - SB)

INCONT - Event code: (See Appendix F.)

PTRUP - FEL pointer to preceding event block for the player scheduling the event.

PTRDOWN - FEL pointer to following event block for the player scheduling the event.

MSG - pointer to the MESSAGE block. Used only when a message event has been scheduled.

TIME - Time of the event. Stored as a real variable.

b) <u>LEFTREE Node</u>

TIME	-	Time of the event. Stored as a real variable.
PEVENT	-	pointer to the EVENT block.
DIST	-	Minimum distance (in nodes) from a node (LEFTREE) to a leaf of the leftist tree. (Note: leaves are vacuous)
PLEFT	-	Pointer to LEFTREE node on the right of the DEL tree.

c) <u>MESSAGE Block</u>

PTR	-
FREQ	-
VALUE 1	-
VALUE 2	-
VALUE 3	-

e. <u>Linkages to other Data Structures</u>

The event blocks are linked to the unit scoreboards (SB) of both the player initiating the event and the player to be processed by the event. The DEL and FEL are also pointed to by the pointers TREETOR and PTRFEL, respectively. In addition, the EVENT blocks are pointed to be the following data blocks:

BOCSTAT	DIL	PAL
BTRYDIL	ENGAGE	SB
BTRYSTAT	FIREUNIT	

f. <u>Notes</u>

The MADEM event code definitions listed in Appendix F indicate the code number of each MADEM event and the subroutine in which event processing occurs.

2. Hex Address Tree and Related Lists

a. Data Block Index

BUFFER

HEX

HEXELEV

LINK

b. Description

Terrain information and the position of units in the hexagonal coordinate system is stored in the HEX ADDRESS TREE and its associated PEEPER and UNIT OCCUPANCE lists.

The HEX ADDRESS TREE is composed of HEX blocks arranged in a hierarchical tree structure. Each of the levels in the tree corresponds to a level in the hexagonal coordinate system. Table III-3 indicates the levels at which various types of information are stored in the HEX blocks terrain field as well as the levels at which PEPPER and UNIT OCCUPANCY lists are maintained.

UNIT OCCUPANCY and PEEPERS lists may be attached to HEX blocks at various levels in the HEX ADDRESS TREE structure. These linked lists are composed of a BUFFER block and a chain of LINK blocks.

The UNIT OCCUPANCY LIST (UOL) contains pointers to the scoreboards (SB) of units which occupy the HEX at the specified level.

The PEEPER LIST (PL) contains pointers to the scoreboards (SB) of units which can SEE INTO the hex.

1) Structure Diagram (Figure III-3)

2) Block Definitions

HEX	-	HEX BLOCK. Contains HEX number, tree pointers, unit occupancy list and peeper list pointers and terrain pointer.
BUFFER	-	BUFFER BLOCK. Used by PEEPER and UNIT OCCUPANCY lists. Contains pointers to scoreboards (SB).

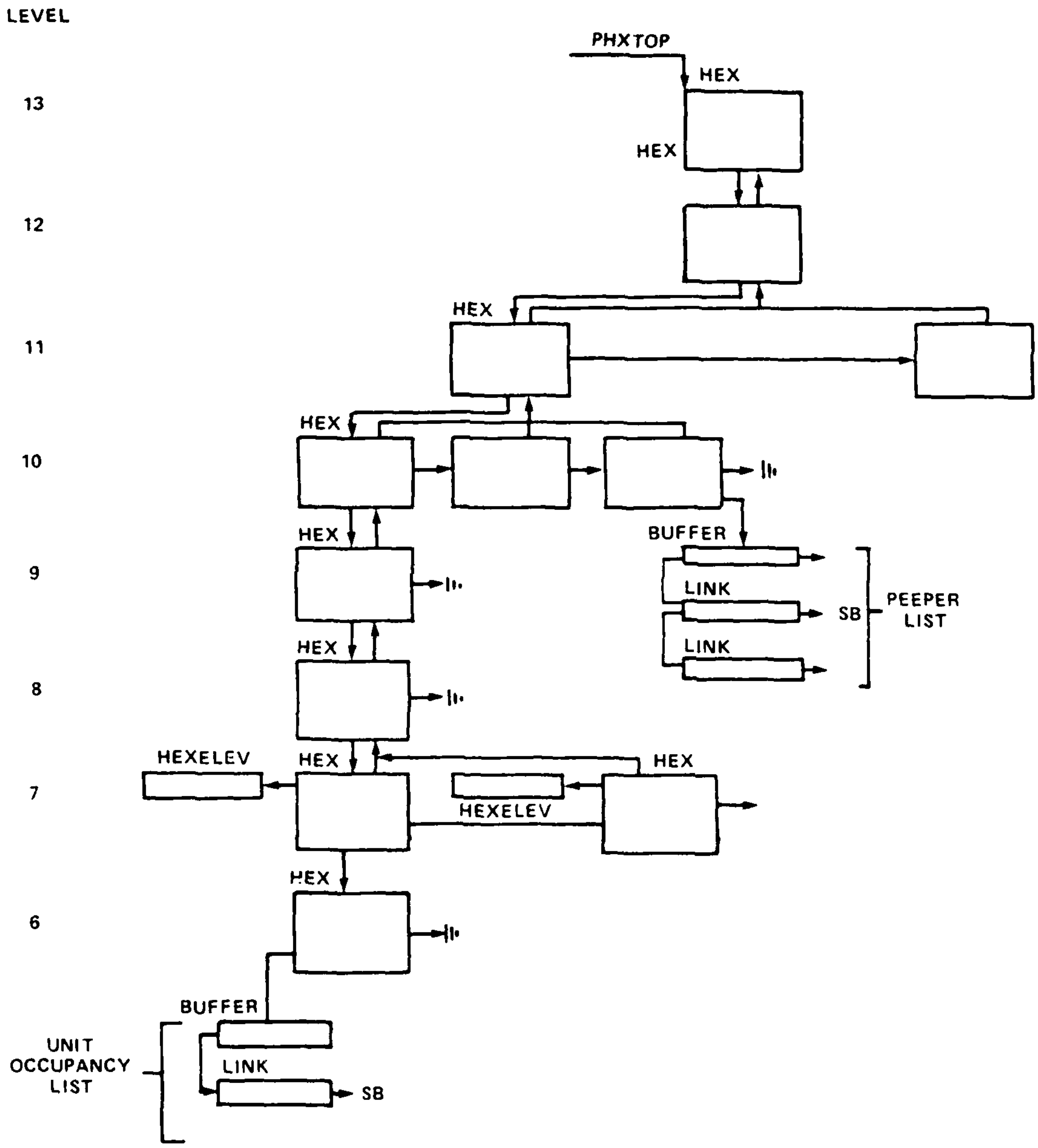


Figure III-3. Hex Tree Structure Diagram

4368/79W

TABLE III-3.

HEX BLOCK DATA SPECIFICATIONS

HEX LEVEL DEC	HEX LEVEL OCT	NO. OF HEX DIGITS	HEX DIAMETER (KM)	HEX AREA d^2 3 /2	STORAGE
13	15	o	8575.	63,700,000	
12	14	1	3240.	9,100,000	
11	13	2	1225.	1,300,000	
10	12	3	463.	185,600	1
9	11	4	175.	26,500	
8	10	5	66.1	3,790	
7	7	6	25.	541	2
6	6	7	9.45	77	3

1 • Pointer to the PEEPER list is active at this level.

2 • Pointer to elevation storage block active at this level.
  • Pointer to PEPPER list active
  • Pointer to Unit occupancy list active

3 • Pointer to Unit occupancy list active.

d. Block Specifications

1). Block Diagrams

a) HEX

HEXNUMBER	LEVEL
PUP	PDOWN
TERRAIN	PNEXT
PUOL	PEEPER

b) HEXELEV

ELEVAT (SPACE)

c) BUFFER

PSTART	NUMLINK

d) LINK

PNEXT	PSB

2) Field Definitions

a) HEX Block

HEXNUMBER - HEX NUMBER (up to 7 Octal Digits)

LEVEL - HEX LEVEL (13 - 6 used in MADEM)

PUP - Pointer to parent. HEX block

PDOWN - Pointer to daughter HEX block

TERRAIN - At level 7 points to HEXELEV which contains altitude of the hex in meters

PUOL - Pointer to unit occupancy list buffer block at Level 6

PEEPER - Pointer to PEEPER LIST buffer block at Level 10.

b) HEXELEV Block

ELEVAT - Elevation in meters. Stored as a real variable.

c) Buffer Block

PSTART - Pointer to first list block

NUMLINK - Number of links in list block chain.

d) Link Block

PNEXT - Pointer to next link block

PSB - Pointer to unit scoreboard

e. Linkages to other Data Structures

Link blocks point to the unit scoreboards (SB) of units which occupy a hex in the UOL list and units which can be seen from a hex in the PEEPER LIST.

f. Notes

- It appears that in the unMIDASized version of the model the BUFFER BLOCK is not used. However, it was included in this documentation because it exists in the MIDAS tables.
- UOL and PL's may exist at all levels in the hex tree.

E. COMMAND/CONTROL STRUCTURES

The command/control structures are used to simulate the command and control functions associated with the NATO and PACT command hierarchies. The three structures in this category include the PLAYER's LISTS, C2 TREES, and the PASSIVE TARGET LIST. The players lists are used to access particular unit types. They are used extensively by the semantic processing routines to assemble the red and blue C2 TREES. The C2 TREES represent the hierarchies of red and blue players in the model. They are the core of the command/control simulation. The PASSIVE TARGET LIST is a list of blue units that are *not* part *of* the C2 *simulation*, but merely targets for red attacks. These structures are explained in detail in the following subsections.

1. Player Lists

a. Data Block Index

PLAYERBUFFER

PLYST

C2

b. Description

The red and blue PLAYER LISTS are used to access COMMAND/CONTROL blocks (C2) of specified types. This structure allows the semantic processing routines to access units without traversing the C2 TREE. This capability is used to construct the C2 TREE in response to VOIL input.

The PLAYER LIST structures consist of a buffer word (PLAYER-BUFFER) which points to an array (PLYST) within ISPACE which is dimensioned to the largest number of units in the scenario. Each word in the PLYST array contains a unit type code and a pointer to a C2 block of that type.

c. Structure Overview

1) Structure Diagram (Figure III-4)

2) Block Definitions

PLAYERBUFFER	Player List Buffer.
PLYST	Player List Array. Contains unit type codes and corresponding pointers to C2 blocks
C2	Command/Control Block. Contains pointers for C2 Tree. Along with unit number, side and type.

d. Block Specifications

1) Block Diagrams

a) PLAYERBUFFER

PTRPL	VARWORD

b) PLYST

ILW	IRW
ILW	IRW

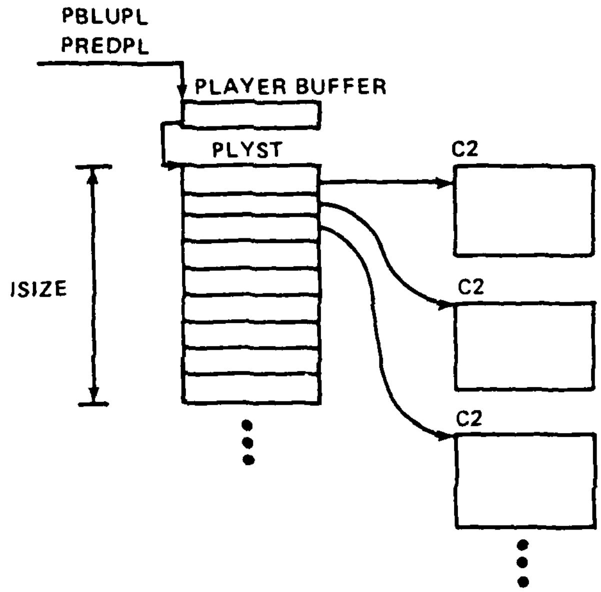


Figure III-4. Player List Structure Diagram

4368/79W

c) C2

UNIT NUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

2) Field Definitions

a) PLAYERBUFFER Block

PTRPL	Pointer to PLYST Player List
VARWORD	Total number of players in the list

b) PLYST Array

ILW	Unit type code (See subsection f)
IRW	Pointer to the unit's C2 block.

c) C2 Block

UNITNUMBER	Number of the unit. If negative the unit is a passive target.
PUP	Pointer to the C2 Block of the unit's commander.
PDOWN	Pointer to the C2 block of the unit's subordinate.
PNEXT	Pointer to the C2 block of the unit's sibling.
PSB	Pointer to the SB block of the unit.
UNITTYPE	the unit's type code. (See subsection f)
SIDE	Unit Affiliation. 1 = Blue (NATO) 2 = Red (PACT)

e. Linkages to Other Data Structures

The player lists are linked via the C2 blocks to the C2 Tree and Passive Target Lists.

f. <u>Notes</u>

The <u>UNITTYPE Code Definitions</u> used in MADEM are listed in Appendix G.

MADEM UNITTYPE CODE DEFINITIONS

Name	Decimal Number	Octal Number
HAWK BTRY	170	252
HGRC BTRY	180	264
PAT BTRY	175	257
HAWK BOC	150	226
HERC BOC	160	240
PAT BOC	155	233
CRC	130	202
AIR BASE	220	334
TAB	158	236
AWACS	132	204
LANCE	86	126
HJ	34	42
BRIDGE	39	47
DEPOS	40	50
PERSHING	83	123
POL	84	124
SASP	210	322
ASP	87	127
RESERVES	88	130
TRAINS	89	131
CLV BTRY	94	136
VII BTRY	90	132
CORP CP	95	137
DIV CP	92	134
SOC	153	231
ATAF	128	200

AIRCRAFT UNITTYPE CODES (INTERNAL)

	Decimal	Octal
BLUE	401 - 419	621 - 643
AWAC	499	763
RED	Decimal	Octal
Fighters	420 - 439	644 - 607
F/B	440 - 459	670 - 713
Bombers	460 - 478	714 - 737
Unassigned	480 - 498	704 - 762

2. C2 Trees

a. Data Block Index

C2

PLBUFFER

SB

SDB

b. Description

Two tree data structures are used to represent the command and control hierarchies for the Blue (NATO) and Red (PACT) forces. Only player, as opposed to passive target, units are included in these trees. The overall structure of these trees is shown in the structure diagram below. The command and control hierarchies for red and blue forces used by the model are shown in subsection f.

c. Structure Overview

1) Structure Diagram (Figure III-5)

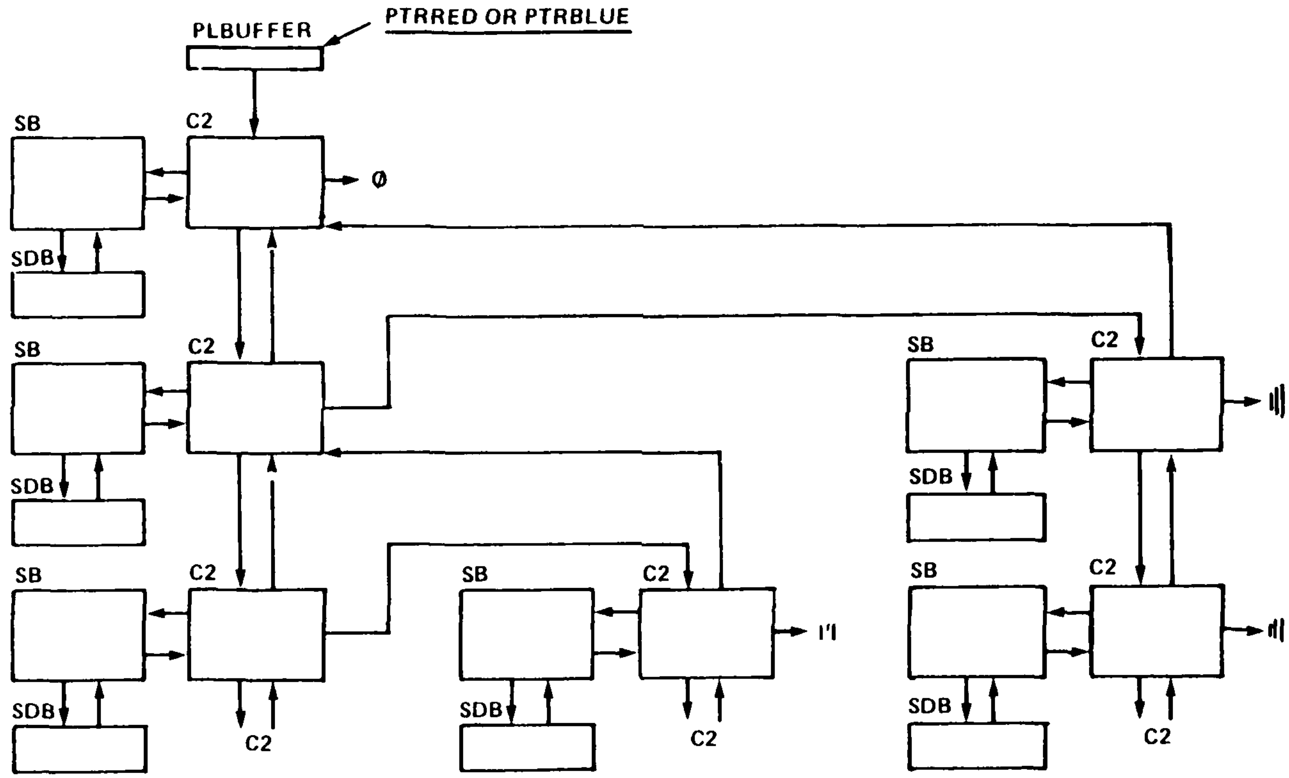
2) Block Definitions

PLBUFFER - C2 Tree Buffer Block. Contains pointer to the tree ans the side of the tree.

- Command/Control Block. Contains tree pointers, unit number, pointer to scored (SB), unit type code and side.

SB - Scoreboard Block. Contains pointers to C2 and HEX blocks, and the status display board (SDB). Also contains pointers to acquisition devices vairous unit status blocks and the future event list. Use varies with unit type.

SDB - Status Display Board Block. Contains subordinate, acquisition and order pointers. Use varies with unit type.



4368/79W

Figure III-5. C2 Tree Structure Diagram

d. Block Specifications

1) Block Diagrams

a) PLBUFFER

PTRPL	VARWORD

b) C2

UNIT NUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

Note: + Alternate Definition of Field

c) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PABSTATNS
	+PARCFTSTAT
	+RBOCSTAT
	+PBTRYSTAT
	+STATUS

d) SDB

PSB	PSEEBUF
	+PSEE
SUBORDINATE	ORD
	+PRAID

Field Definitions

a) PLBUFFER Block

PTRPL Pointer to C2 block

VARWORD Side Indicator for tree:

[illegible] = Blue (NATO)

[illegible] = Red (PACT)

b) C2 Block

UNITNUMBER	-	Number of the unit. If negative the unit is a passive target.
PUP	-	Pointer to the C2 block of the unit's commander
PDOWN	-	Pointer to the C2 block of the unit's subordinate.
PNEXT	-	Pointer to the C2 block of the unit sibling.
PSB	-	Pointer to the SB block of the unit.
UNITTYPE	-	The unit's type code (see subsection f)
SIDE	-	Unit Affiliation. 1 = Blue (NATO) 2 = Red (PACT)

c) SB Block

ADDRESS	-	Pointer to HEX block of the HEX in which the unit is located
PC2	-	Pointer to C2 block of the units.
PSDB	-	Pointer to the SDB block of the unit.
PFEL	-	Pointer to future event list event block.
PACQ	-	Pointer to ACQBUF block. Used by CRC's for acquisition devices.
ID	-	Identification number
DATABASE	-	If BOC or BTRY points to ADSITEDG block
PABSTATUS	-	Points to ABSTATUS block if the unit is an air base
+PARCFTSTAT	-	Points to ARCFTSTATUS block if the unit is a flight of aircraft.

+PBOCSTAT	-	Points to BOCSTAT block if the unit is a battalion operations center.
+PBTRYSTAT	-	Points to BTRYSTAT block if the units is an antiaircraft battery.
+STATUS	-	Alternative Field Definition.

d) SDB Block

PSB	-	Pointer to the unit's SB block.
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record damage levels. This field definition is used only by flights.
+PSEE	-	Pointer to CRCEES block which is used by CRC units to record the blue and red flights it sees, and by the TRC as a pointer to its assigned targets list TARGETLISTBLOK.
SUBORDINATE	-	Points to different types of subordinate description or target desciption blocks depending upon the unit type. Possible unit type vs. field use combinations are as follows:

Unit Type	Subordinate Points to
CRC	SUB
BOC	SUBLIST
BTRY	Fireunit

ORD	-	Points to Orders block if the unit is a flight.

+PRAID - Points to the RAIDBLOK if the unit is the red theater commander.

e. Linkages to other Data Structures

The C2 TREES are linked to various unit status structures depending upon the type of unit represented by the C2 blocks.

f. Notes

Figures III-6, and III-7 show the hierarchies of blue and red player units. These hierarchies are representative of model processes only and are not direct models of the real world.

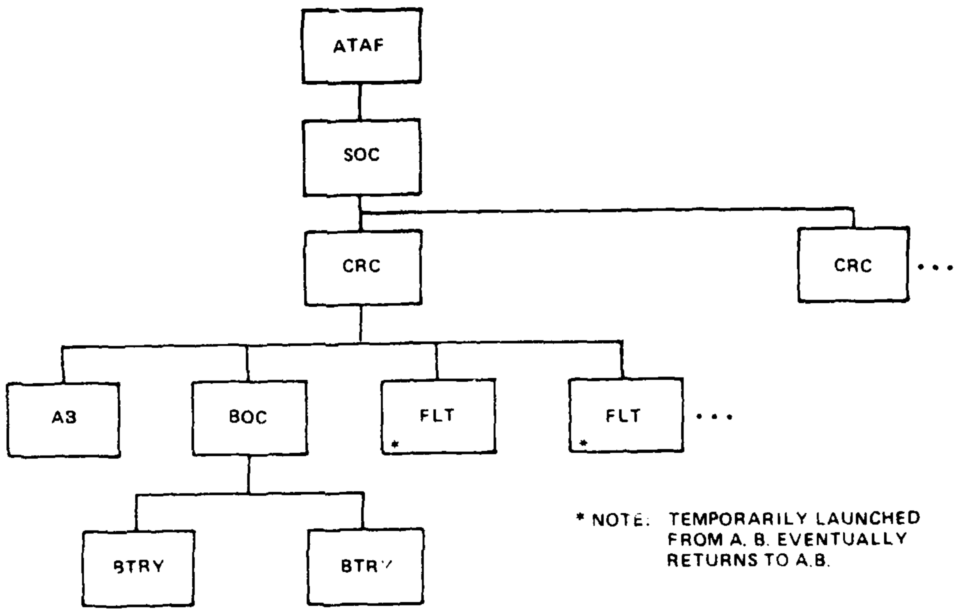


Figure III-6. Blue Command/Control Structure

4368/79W

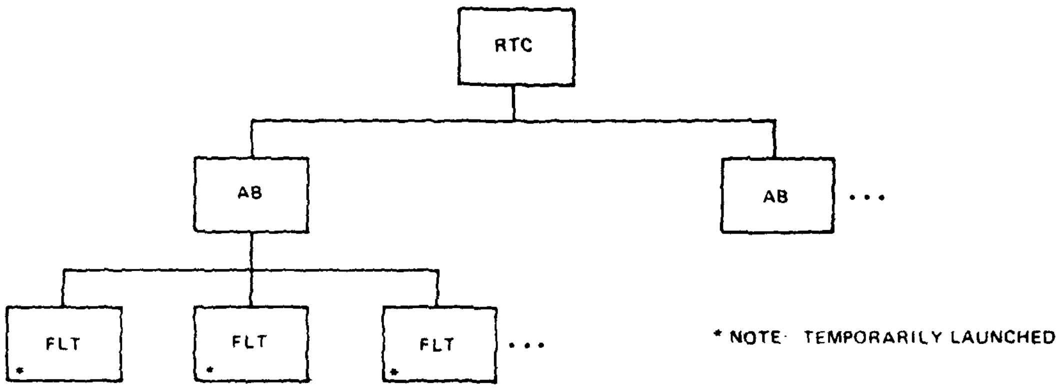


Figure III-7. Red Command/Control Structure

4368/79W

3. Passive Target List

a. Data Block Index

C2

SB (Modified)

b. Description

The PASSIVE TARGET LIST is made up of C2 and associated SB blocks which are in a linked list. This list is separate from the C2 TREE and is used to represent Blue units which are non-players. These Blue units are non-players in the sense that they merely act as objectives for red attacks.

Passive target units are characterized by negative unit numbers in their C2 blocks and a modified SB block which has three rather than the usual four words. The configuration of the passive target list is shown in the structure diagram.

c. Structure Overview

1) Structure Diagram (III-8)

2) Block Definitions

C2 - Command/Control Block. Contains list pointers, a negative unit number, pointer to SB, unit type code and side.

SB (Modified) - Scoreboard Block. Three rather than the usual four words. Contains pointers to C2 and HEX blocks.

d. Block Specifications

1) Block Diagrams

a) C2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

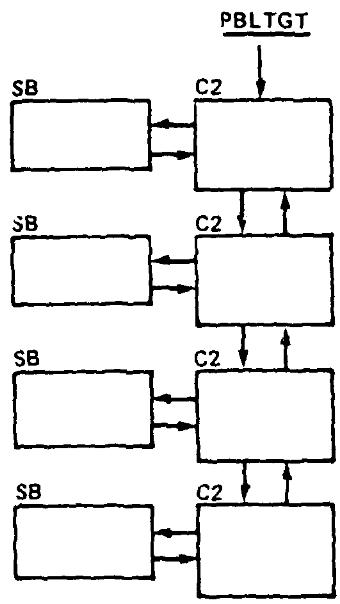


Figure III-8. Passive Target List Structure Diagram

4368/79W

b) SB (Modified)

ADDRESS	PC2
PSDB	PEEL
PACQ	ID

2) Field Definitions

a) C2 Block

UNITNUMBER - Number of the Unit. If negative, the unit is a passive target.

PUP - Pointer to the C2 block of the units commander.

PDOWN - Pointer to the C2 block of the unit's sibling.

PSB - Pointer to the SB block of the unit.

UNITTYPE - The unit's type code (see subsection f)

SIDE - Unit Affiliation.
1 = Blue (NATO)
2 = Red (PACT)

PACQ - Pointer to ACQBUF block. Used by CRC's for acquisition devices (not used)

ID - Identification Number

e. Linkages to Other Data Structures

The PASSIVE TARGET LIST is used exclusively for targeting by the red planning module. Its only external unrage is to the HEX block in which the unit is located.

f. Notes

F. RED STRUCTURES

The Red Structures are used to simulate the Red Threat Planning and attack processes. The Red Theater Commander (RTC) is the focal point of all other Red Structures. The RED THEATER COMMANDER structures together with its associated CORRIDOR DESCRIPTION lists and ATTACK REQUIREMENTS/ ALLOCATIONS lists controls the assignment of flights to specific targets. Potential targets are obtained from the POTENTIAL TARGET LIST and placed on either the ASSIGNED TARGET list or NONAVAILABLE TARGET list by the RTC. Orders are then generated for each flight which determine the mission profile for the COMMINS attack. Once flights have been launched many of the planning structures mentioned above are no longer required. They are therefore released for other uses.

1. <u>Red Theater Commander</u>

a. <u>Data Block Index</u>

C^2

RAIDBLOK

SB

SDB

STDBLOK

TARGETLISTBLOK

TTDBLOK

WAVEBLOK

b. <u>Description</u>

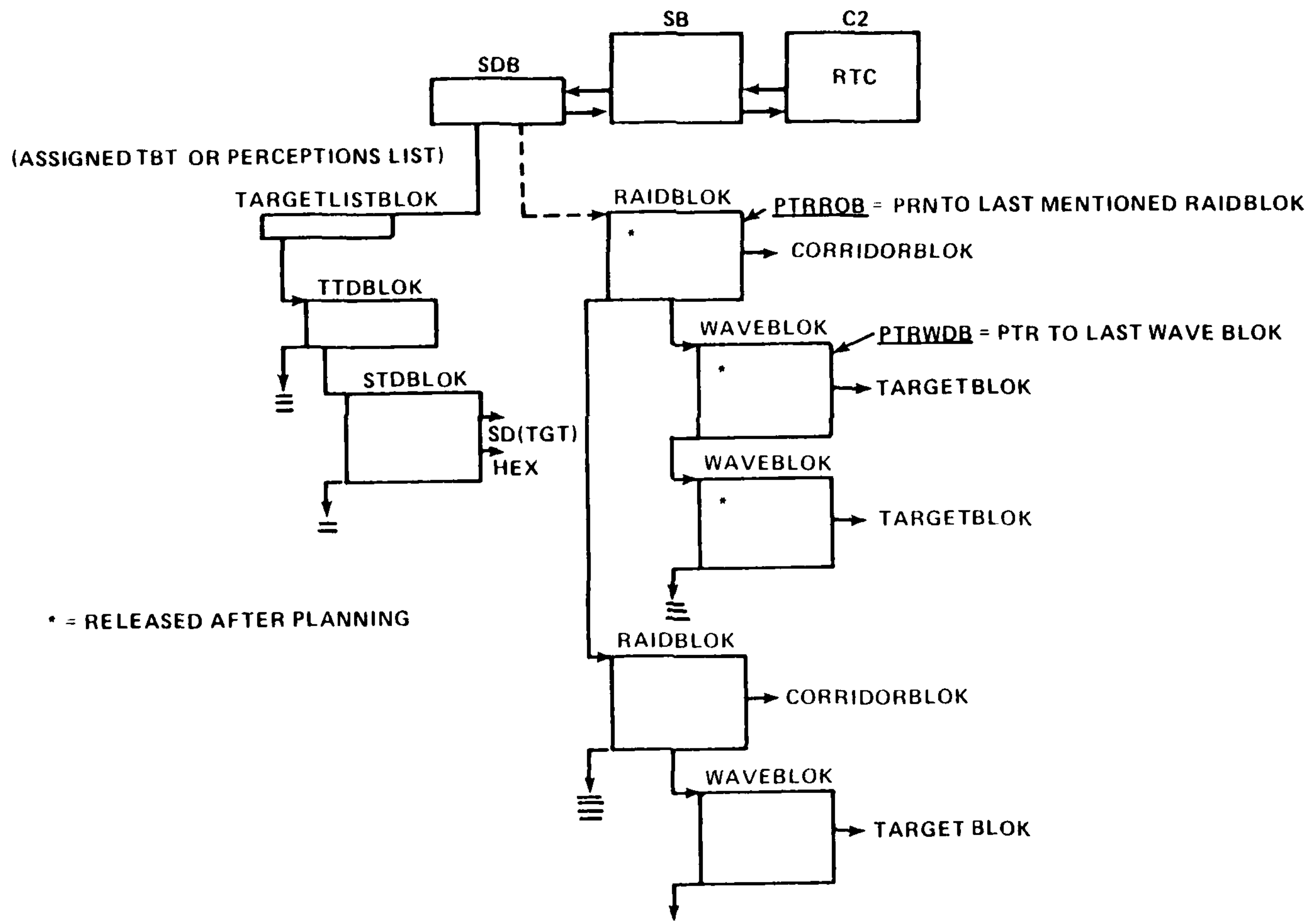
The Red Theater Commander is the core of the Red Attack Planning Process. It controls execution of raids and waves through its RAIDBLOK/WAVEBLOK list. Similarly, choice of targets is controlled by the commander's PERCEPTIONS LIST (also refered to as the ASSIGNED TARGET LIST). The Red Theater Commander also controls the allocation of flights to targets on its PERCEPTIONS LIST through pointers from its WAVERLOK blocks to the REQUIREMENTS/ALLOCATIONS LISTS. •In addition, pointers from its' RAIDBLOK blocks to CORRIDOR DESCRIPTION LISTS allow the Red Commander to Assign attacks to various corridors.

c. <u>Structure Overview</u> (Figure III-9)

1) <u>Structure Diagram</u>

2) <u>Block Definitions</u>

C^2	-	<u>COMMAND/CONTROL BLOCK</u>. Contains unit no, type, side and C^2PTRS.
<u>SB</u>	-	<u>SCOREBOARD BLOCK</u>. Contains HEX PTR, Unit ID, PTR to FEL.
<u>SDB</u>	-	<u>STATUS DISPLAY BLOCK</u>. Contains PTRS to assigned tgt list (perceptions list) and RADIBLOK initialization.
<u>RAIDBLOK</u>	-	<u>RAID DESCRIPTION BLOCK</u>. Contains basic parameters for a raid including no. of waves and corridors.



4368/79W

Figure III-9. Red Theater Commander Structure Diagram

WAVEBLOK - WAVE DESCRIPTION BLOCK. Contains basic parameters for a wave including no. of tgt types, start time and duration.

TARGETLISTBLOK - TARGET LIST BUFFER. Contains number of tgt type (TTDBLOK) blocks in the list

TTDBLOK - TARGET TYPE BLOCK. Contains TGT type code and PTR to next TTDBLOK type, also contains PTR to a list of specific tgts of the same type (STDBLOK) and a count of the no. of specific targets.

STDBLOK - SPECIFIC TARGET DESCRIPTION BLOCK. Contains PTRS to tft SB and HEX and to its TGTPTREE. Also contains perceived damage lavel and a PTR to the next STDBLOK.

d. Block Specifications

1) Block Diagrams

a) C^2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATA BASE	PABSTANS
	+ PARCPTSTAT
	+ PBOCSTAT
	+ PBTRYSTAT
	+ BTATUS

c) SDB

PSB	PSEEBUF
+	PSEE
SUBORDINATE	ORD
+	PRAID

d) TARGET LIST BLOK

PTRTYTL	NOTYTPL

d) TTDBLOK

PNEXT	NRTGTYP
PTGTPL	NOTGTPL

f) STDBLOK

PNEXT	PTGTSB
	PTGTLTR
DAMAGPER (SPACE)	
	PADRPER

g) RAIDBLOK

PNEXT	NRRAID
PTRWAVE	NDWAVES
PTALORD	NOCORDS

h) WAVEBLOK

PNEXT PTGTYPE	NRWAVE NOTGTYP
STARTIME (SPACE) DURATION (SPACE)	

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MODULAR AIR DEFENSE EFFECTIVENESS MODEL, PROGRAM DOCUMENTATION --ETC(U)

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2) Field Definitions

a) C^2 BLOCK

UNITNUMBER	-	number of the unit.
PUP	-	Pointer to the C^2 block of the unit's commander.
PDOWN	-	Pointer to the C^2 block of the unit's subordinate.
PNEXT	-	Pointer to the C^2 block of the unit's sibling.
PSB	-	Pointer to the SB block of the unit.
UNITTYPE	-	The Unit's type code.
SIDE	-	Unit affiliation. 1 = BLUE 2 = RED (PACT)

b) SB Block

ADDRESS	-	Pointer to HEX block of the hex in which the unit is located.
PL2	-	Pointer to C^2 block of the unit.
PSDB	-	Pointer to the SDB block of the unit.
PFEL	-	Pointer to future event list EVENT block.
PACQ	-	Pointer to ACQBUF block. Used by CRC's for acquisition devices.
ID	-	Identification number.
DATABASE	-	If BOC or BTRY points to ADSITEDB block.
PBSTATUS	-	Points to ABSTATUS block if the unit is an airbase.

+ PARCFTSTAT - Points to AFCFTSTATUS block if the unit is a flight of aircraft.

+ PBOCSTAT - Points to BOCSTAT block if the unit is a battalion operations center.

+ PBTRYSTAT - Points to BTRYSTAT block if the unit is an antiaircraft battery.

+ STATUS - Alternative Field Definition.

c) SDB Block

PSB - Pointer to the Unit's SB block.

PSEEBUF - Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their perceived damage levels. This field definition is used only by flights.

+ PSEE - Pointer to CRCEES block which is used by CRC units to record the blue and red flights it sees. Also used by the RTC to point to its assigned targets list TARGETLISTBLOK.

SUBORDINATE - Points to different types of subordinate description or target description blocks depending upon the unit type. Possible unit type vs. field use combinations are as follows:

<u>UNIT TYPE</u>	<u>SUBORDINATE POINTS TO</u>
CRC	SUB
BOC	SUBLIST
BTRY	FIREUNIT

ORD - Points to ORDERS block if the unit is a flight.

+ PRAID - Points to the RAIDBLOK if the unit is the red theater commander.

d) <u>TARGETLISTBLOK BLOCK</u>

PTRTYTL - Pointer to TTDBLOK block

NOTYTPL - Number of TTDBLOK blocks (target types) in the list.

e) <u>TTDBLOK BLOCK</u>

PNEXT - Pointer to next TTDBLOK block in the list

NRTGTYP - Pointer to the STDBLOK block list

PTGTPL - Pointer to the STDBLOK block list.

NGTGTPL - Number of STDBLOK blocks in the list.

f) <u>STDBLOK BLOCK</u>

PNEXT - Pointer to the next STDBLOK block in the ASSIGNED TARGET LIST.

PTGTSB - Pointer to SB block of the specific target.

PTGTLTR - Pointer to TGTPTREE node

DAMAGPER - Perceived damage to target. Stored as a real variable. Initialized to 2.

PADRPER	-	Pointer to HEX block in which target unit is located.

g) RAIDBL BLOCK

PNEXT	-	Pointer to the next RAIDBLOK block in the RAIDBLOK list.
NRRAID	-	Raid number.
PTRWAVE	-	Pointer to WAVEBLOK BLOCK. First in list.
NOWAVES	-	Number of waves in the list.
PTRCORD	-	Pointer to first CORRIDORBLOK in the CORRIDOR DESCRIPTION LIST.
NOCORDS	-	Number of corridors.

h) WAVEBLOK BLOCK

PNEXT	-	Pointer to the next WAVEBLOK block is the list.
NRWAVE	-	Wave number
PTGTYPE	-	Pointer to first TARGETBLOK block in the list of target types to be attacked in the wave.
NOTGTYP	-	Number of target types in the wave.
STARTIME	-	Start time. Real variable
DURATION	-	Length of wave. Real variable.

e. Linkages to Other Data Structures

The Red Theater Commander shares its STDBLOK blocks with the POTENTIAL TARGET LIST and the NONAVAILABLE TARGET LIST. In addition, its RAIDBLOK blocks point to the CORRIDOR DESCRIPTION STRUCTURES and its WAVEBLOK blocks point to the attack REQUIREMENTS/ALLOCATION structures.

f. Notes

2. Potential Target List

a. Data Block Index

FOREST

FORTGTBUFFER

STDBLOK

TGTPTREE

b. Description

The POTENTIAL TARGET LIST is used to keep track of potential targets by the Red Theater Planning Module. It consists of a linker list of FOREST blocks. Each of which corresponds to a particular target type found in the Blue C^2 TREE and PASSIVE TARGET LIST (See D.2 and D.3). Each FOREST block points to a leftist tree composed of linked TGTPTREE and STDBLOK blocks. These trees contain location, damage and command/control information for specific targets of the type found in the origin FOREST blocks. These specific target trees are sometimes referred to as PROBABALISTIC EVENT TREES.

Within each tree the TGTPTREE blocks act as the nodes of the tree while the STDBLOK blocks act as repositories of key information on the target. The nodes of the tree are sorted by damage level with the least damaged target residing at the top of the tree. For a complete explanation of the leftist tree sorting algorithm see APPENDIX E. Perceived damage is stored in STDBLOK while actual damage is stored in TGTPTREE block.

STDBLOK blocks may be strung into linked lists to form the assigned target list discussed in E.2. The overall configuration of the POTENTIAL TARGET LIST is shown in the structure diagram.

c. Structure Overview

1) Structure Diagram (Figure III-10)

2) Block Definitions

FORTGTBUFFER	-	FOREST LIST BUFFER BLOCK. Contains number of forest blocks.
FOREST	-	TARGET TYPE BLOCK. Contains TGTTYPE code and a PTR to a tree of specific targets of that type.

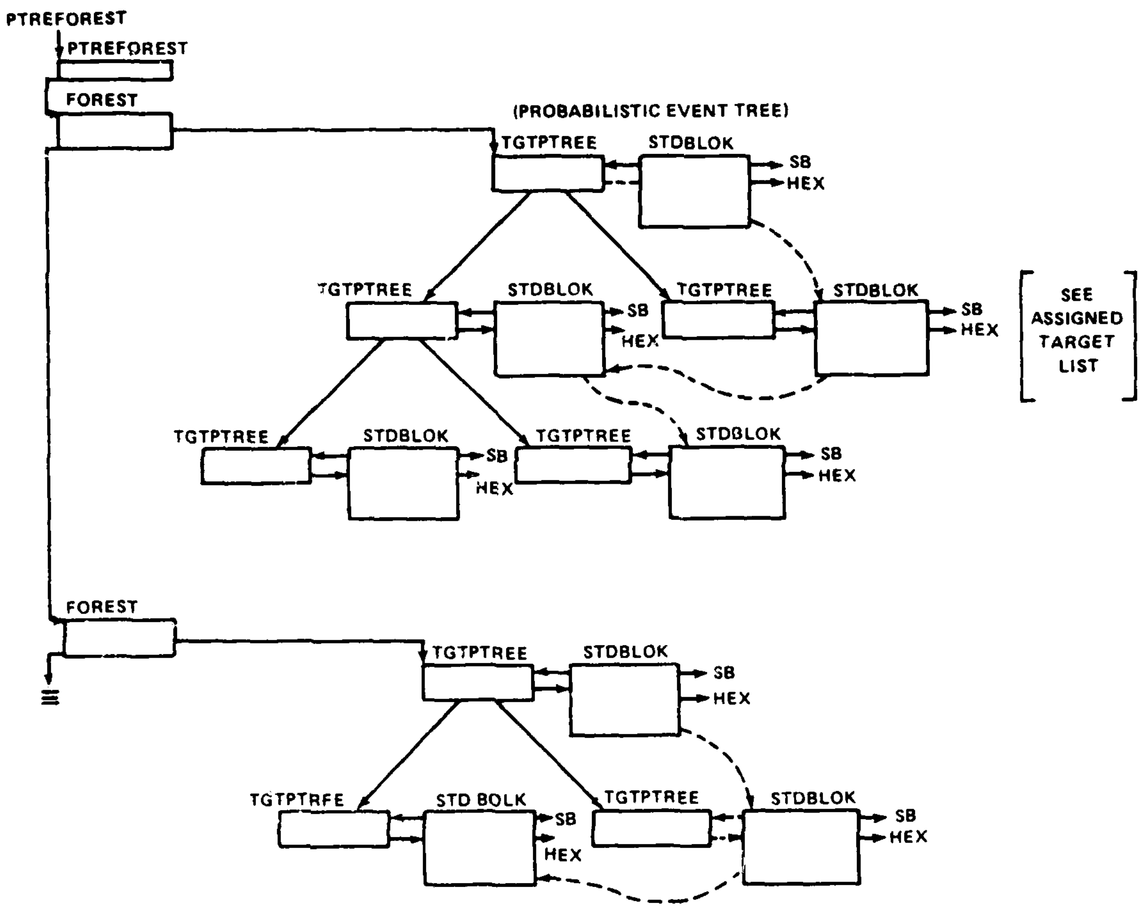


Figure III-10. Potential Target List Structure Diagram

4368/79W

TGTPTREE - TARGET TREE NODE. Contains PTAS to left and right nodes of leftist tree used to sort specific TGTS by damage level. Also contains PTR to its corresponding STDBLOCK. TGTPTREE damage level is the actual damage level.

STDBLOK - SPECIFIC TARGET DESCRIPTION BLOCK. Contains PTRS to TGT SB and HEX and to its corresponding TFTPTREE. Also contains the perceived damage level for the TGT. STDBLOCKS have a PNEXT field which allows them to be threaded into a linked list of assigned targets.

d. Block Specifications

1) Block Diagrams

a) FORTGTBUFFER

PFOREST	VARWORD

b) FOREST

PNEXT	NRTYPE
PTREE	

c) TGTPTREE

DAMAGE			
PSTDBLOK	DIST	PLEPT	PRITE

d) STDBLOK

PNEXT PTGTSB
PTGTLTR
DAMAGPER
PADRPER F-9

2) Field Definitions

a) FORTFTBUFFER BLOCK

PFOREST	-	Pointer to FOREST block.
VARWORD	-	Not used

b) FOREST BLOCK

PNEXT	-	Pointer to next FOREST block.
PTREE	-	Pointer to top TGTPTREE block in probabilistic event tree.

c) TGTPTREE NODE

DAMAGE	-	Actual damage to the target. Stored as a real variable. Initialized to 2.0
PSTDBLOK	-	Pointer to STDBLOK block.
DIST	-	Distance leaf of the tree in nodes.
PLEFT	-	Pointer to left TGTPTREE node in the tree
PRITE	-	Pointer to right TGTPTREE node in the tree.

d) STDBLOK BLOCK

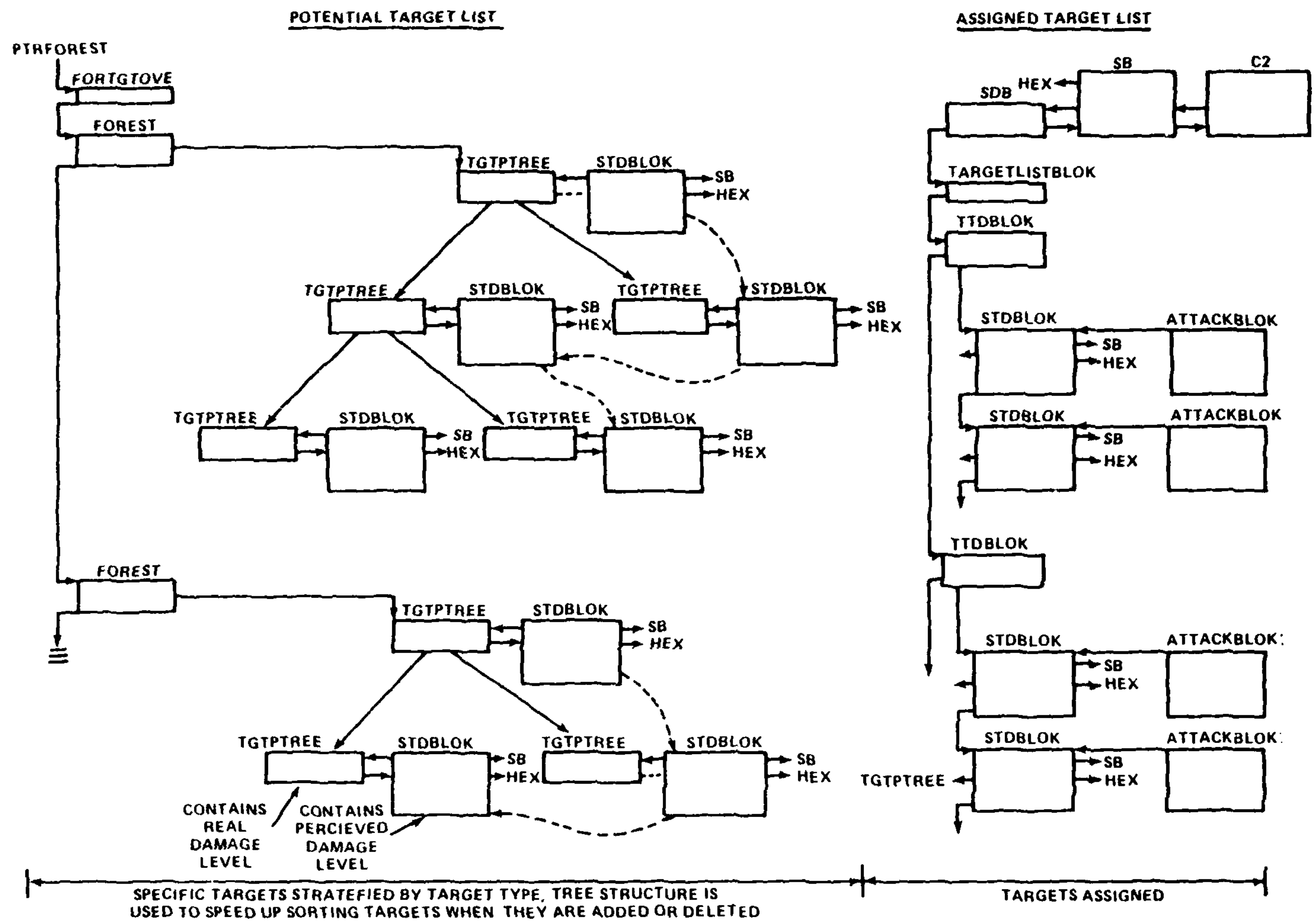
PNEXT	-	Pointer to the next STDBLOK block in the ASSIGNED TARGET LIST.
PTGTSB	-	Pointer to SB block of the specific target.
PTGTLTR	-	Pointer to TGTpTREE node
DAMAGPER	-	Perceived damage to target. Stored as a real variable. Initialized to 2.
PAORPER	-	Pointer to HEX block in which target unit is located.

e. Linkages to other Data Structures

The POTENTIAL TARGET LIST shares its STDBLOK blocks with the ASSIGNED TARGET LIST and the NONAVAILABLE TARGET LIST.

f. Notes

The relationship of the potential and assigned target lists is illustrated in Figure III-11.



4368/79W

Figure III-11. Potential/Assigned Target List Structures

3. Assigned Target List

(Red Commander Perceptions List)

a. Data Block Index

ATTACKBLOK

SDB

STDBLOK

TARGETLISTBLOK

TTDBLOK

b. Description

The ASSIGNED TARGET LIST is used by the Red Theater Planning module to keep track of targets designated for attack in the current raid. It is actually a series of nested lists with lists of specific target description blocks (STDBLOK) stratified by target type. The STDBLOK blocks are obtained from the POTENTIAL TARGET LIST. The desired STDBLOK blocks in the potential target list are pointed to be specific target resource allocation blocks (ATTACKBLOK) created by the Red Theater Planner when resources are matched to attack requirements. (See E.4 for further details). The overall configuration of the ASSIGNED TARGET LIST is shown in the structure diagram. The assigned target list is attached to the Red Theater Commander's SDB block.

c. Structure Overview

1) Structure Diagram (Figure III-12)

2) Block Definitions

TARGETLISTBLOK - TARGET LIST BUFFER. Contains number of TGT TYPE (TTDBLOK) blocks in the list.

TTDBLOK - TARGET TYPE BLOCK. Contains TGT type code and PTR to next TTDBLOK type, also contains PTR to 4 list of specific tgts. of the same type (STDBLOK) and a count of the no. of specific targets.

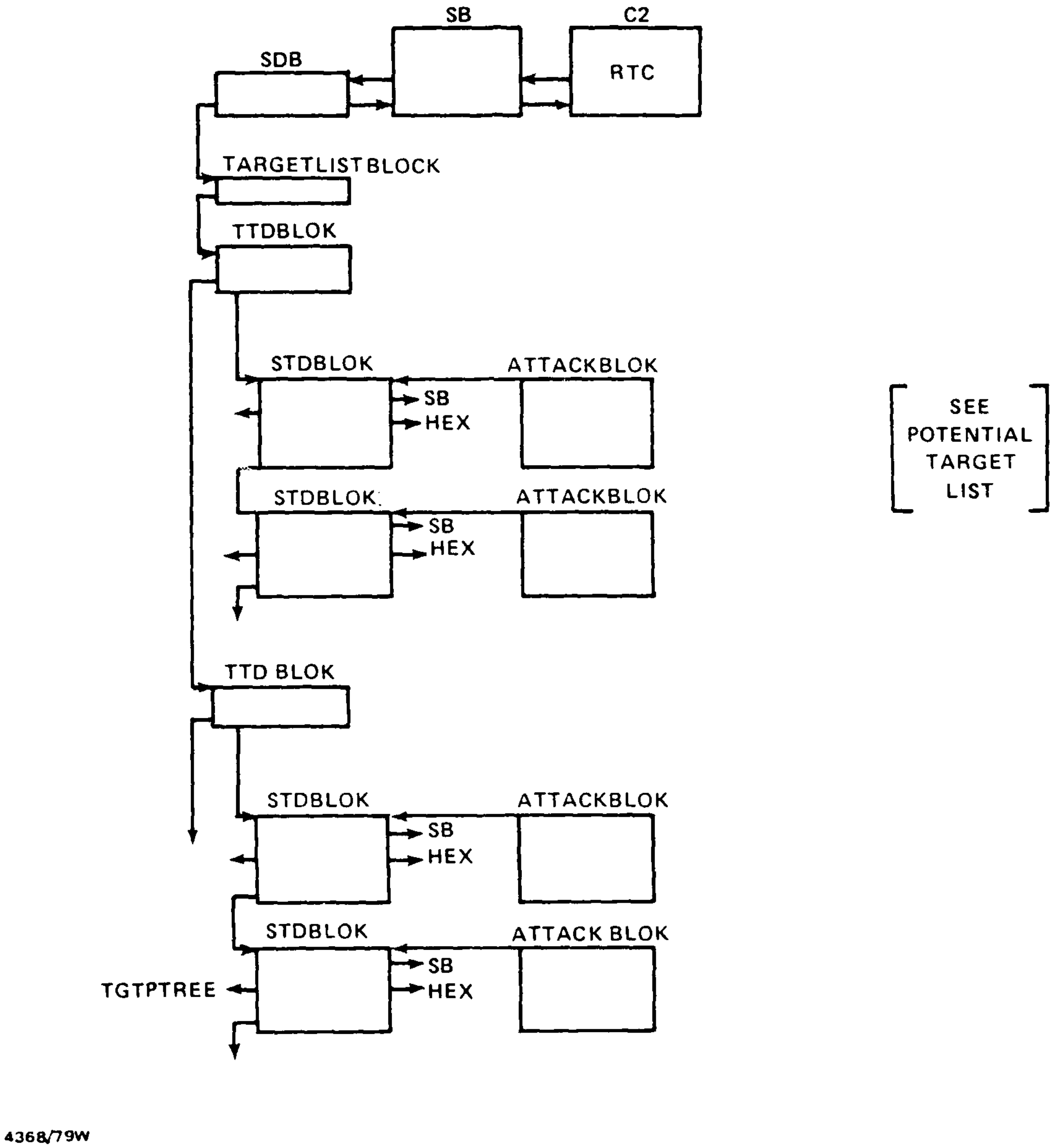


Figure III-12. Assigned Target List Structure Diagram (Red Commander Perception List)

STDBLOK - SPECIFIC TARGET DESCRIPTION BLOCK. Contains PTRS to tgt. SB and HEX and to its TGTPTREE. Also contains perceived damage level and a PTR to the next STDBLOK

SDB - STATUS DISPLAY BOARD of Red Commander

SB - SCOREBOARD of Red Commander

C^2 - COMMAND CONTROL BLOCK of Red Commander

ATTACKBLOK - SPECIFIC TARGET ATTACK RESOURCE ALLOCATION BLOCK for target.

d. Block Specifications

1. Block Diagrams

a) SDB

PSB	PSEEBUF
+	PSEE
SUBORDINATE	ORD
+	PRAID

b) TARGETLISTBLOK

PTRTYTL	NOTYTPL

c) TTDBLOK

PNEXT	NRTGTYP
PTFTPL	NOTGTPL

d) STDBLOK

PNEXT	PTGTSB
	PTGTLTR
DAMAGPER (SPACE)	
	PADRPER

e) ATTACKBLOK

PNEXT	PNXTGTL
PFMAKTC	NOFMAKT
ISECTOR	PNXTCRD

2) Field Definitions

a) SBD BLOCK

PSB	-	Pointer to the Unit's SB block.
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their perceived damage levels. This field definition is used only by flights.
+PSEE	-	Pointer to CRCEES block which is used by CRC units to record the Blue and Red Flights it sees. Also used by the RTC as a pointer to its assigned targets list. TARGETLISTBLOK.
SUBORDINATE	-	Points to different types of subordinate description or target description blocks depending upon the unit type. Possible unit type vs. field use combinations are as follows:

UNIT TYPE	SUBORDINATE POINTS TO
CRC	SUB
BOC	SUBLIST
BTRY	FIREUNIT

ORD	-	Points to ORDERS block if the unit is a flight.
+ PRAID	-	Points to the RAIDBLOK if the unit is the Red Theater commander.

b) TARGETLISTBLOK BLOCK

PTRTYTL	-	Pointer to TTDBLOK block
NOTYTPL	-	Number of TTDBLOK blocks (target types) in the list.

c) TTDBLOK BLOCK

PNEXT	-	Pointer to next TTDBLK block in the list
NRTGTYP	-	Target type code.
PTGTPL	-	Pointer to the STDBLOK block list
NOTGTPL	-	Number of STDBLOK blocks in the list

d) STDBLOK BLOCK

PNEXT	-	Pointer to the next STDBLOK block in the ASSIGNED TARGET LIST.
PTGTSB	-	Pointer to SB block of the specific target.
PTGTLTR	-	Pointer to TFTPTREE node.
DAMAGPER	-	Perceived damage to target. Stored as a real variable. Initialized to 2.
PADRPER	-	Pointer to HEX block in which target unit is located.

e) ATTACK BLOCK

PNEXT	-	Pointer to next ATTACK BLOK in list.
PNXTGTL	-	Pointer to STDBLOK block.
PFMAKTG	-	Pointer to FAKTGBLOK block.
NOFMAKT	-	Number of FAKTGBLOK blocks (formation attacking target) in the list.
ISECTOR	-	Sector of the attack relative to the attack corridor. (see corridor)
PNXTCRD	-	Pointer to the CORRIDOR block for the attack.

e. Linkages to Other Data Structures

The ASSIGNED TARGET LIST shares its STDBLOK blocks with the POTENTIAL TARGET LIST and the NONAVAILABLE TARGET LIST. In addition its STDBLOK blocks are pointed to by ATTACKBLOK blocks which reside in the attack REQUIREMENTS/ALLOCATIONS structure.

f. Notes

Figure III-11 illustrates the relationship of the potential and assigned target lists. This relationship is crutial to an understanding of the target assignment process.

4. Nonavailable Target List

a. Data Block Index

NOAVAILBLOK

STDBLOK

b. Description

The NONAVAILABLE TARGET LIST is used by the Red Theater Planning Module to keep track of targets which cannot be attacked in the current raid. Targets are placed on the NONAVAILABLE TARGET LIST when they are not in the allowable attack shown in Subsection F and when attack resources are not sufficient to match mission requirements. The overall configuration of the nonavailable target list is shown in the structure diagram.

c. Strucutre Overview

1, Structure Diagram (Figure III-13)

2) Block Definition

NOAVAILBLOK	-	NON-AVAILABLE TARGET BLOCK. Created by TGTGONE routine and used by other targets which are not available for attack due to lack of resources or geographic unsuitability. Contains PTR to STDBLOCK and PTR to next NOAVAILBLOK. Also contains perceived damage level. (Projected damage level).
STDBLOK	-	SPECIFIC TARGET DESCRIPTION BLOCK. Contains target SB and HEX PTRS as well as a PTR to the TGTPTREE. Also contains the perceived damage level for the target and a PNEXT field which allows them to be threaded into a linked list of assigned targets.

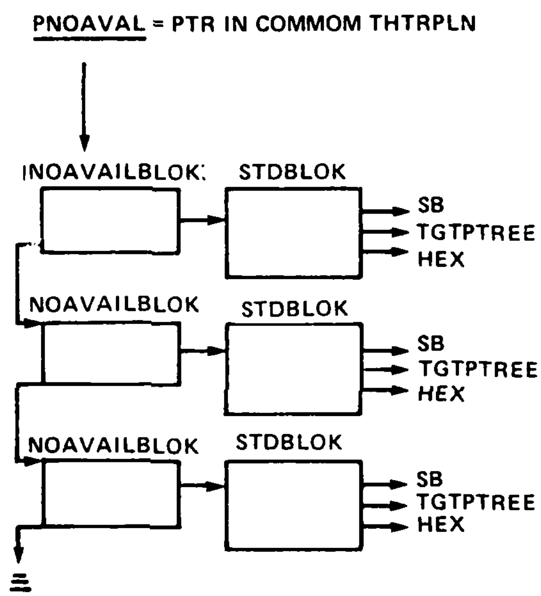


Figure III-13. Nonavailable Target List Structure Diagram

4368/79W

d. Block Specifications

1) Block Diagrams

a) NOAVAILBLOK

PNEXT
PJDAMAGE
PSTDBLOK

b) STDBLOK

PNEXT	PTGTSB
	PTGTLTR
DAMAGPER	
	PADRPER

2) Field Definitions

a) NOAVAILBLOK BLOCK

PNEXT - Pointer to NOAVAILBLOK block

PJDAMAGE - Projected damage level.

PSTDBLOK - Pointer to STDBLOK block on the POTENTIAL TARGET LIST.

b) STDBLOK BLOCK

PNEXT - Pointer to the next STDBLOK block in the ASSIGNED TARGET LIST.

PTGTSB - Pointer to SB block of the specific target.

PTGTLTR - Pointer to TGTPTREE node

DAMAGPER - Perceived damage to target. Stored as a real variable. Initialized to 2.

PADRPER - Pointer to HEX block in which target unit is located.

e. Linkages to Other Data Structures

The nonavailable target list shares its' STDBLOK blocks with the POTENTIAL TARGET LIST and the ASSIGNED TARGET LIST.

f. Notes

Figure III-14 illustrates the attack sectors relative to an attack corridor.

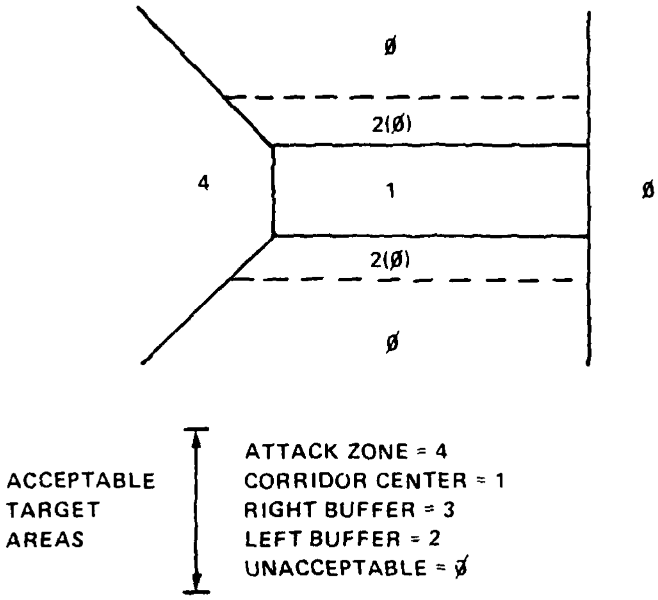


Figure III-14. Attack Sectors

4368/79W

5. Corridor Description Lists

a. Data Block Index

ABVCR

ACTAB

CONSTBLOK

CORRIDORBLOK

HEXBLOK

HEXLINK

b. Description

The CORRIDOR DESCRIPTION LISTS are used by the Red Theater Planning Module to specify the boundaries of the attack corridors input by the user. They are also used to keep track of the assignment of airbases to corridors within aircraft range and the types of aircraft available on the bases. The general configuration of attack corridors is illustrated in Subsection F.

c. Structure Overview

1) Structure Diagram (Figure III-15)

2) Block Definitions

CORRIDORBLOK	-	CORRIDOR DESCRIPTION BLOCK. Contains basic corridor parameters input by user.
CONSTBLOK	-	CORRIDOR CONSTANTS BLOCK. Contains values calculated from corridorblok contents which describe the corridor boundaries.
HEXBLOK	-	HEXLINK BUFFER BLOCK. Contains part to five HEXLINK lists which specify the corridor in terms of hexes.
HEXLINK	-	HEXLINK BLOCK. Contains ptrs. to next HEXLINK and PTR to HEX.

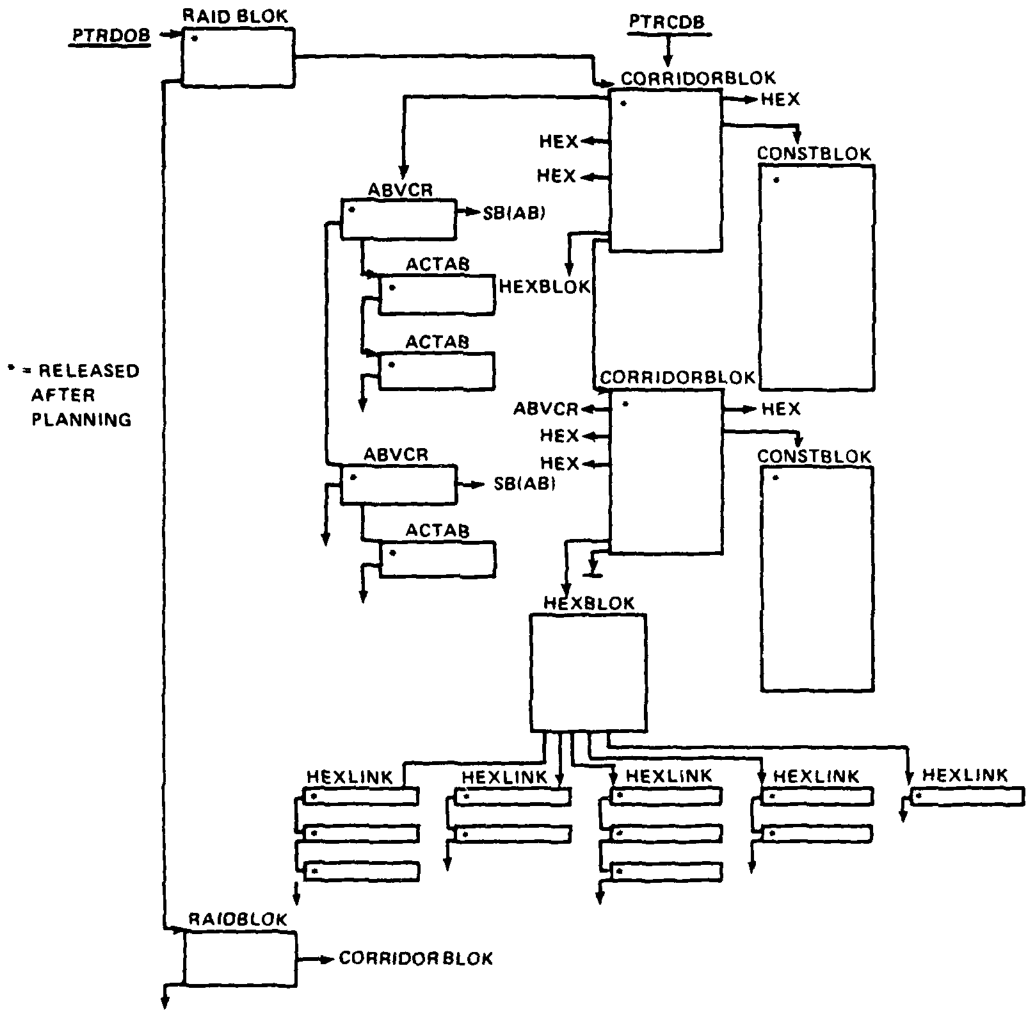


Figure III-15. Corridor Description List Structure Diagram

4368/79W

<u>ABVCR</u>	-	<u>AIR BASE VS. CORRIDOR BLOCK</u>. Air vs. corridor assignment contains PTR to next ABVCR, PTR to air base SB, the number of aircraft on the air base, and PTR to ACTAB list.
<u>ACTAB</u>	-	<u>AIRCRAFT ON AIRBASE BLOCK</u>. Aircraft assignment to airbase. Contains a/c type, no on hand at base, no assigned, and PTR to next ACTAB.

d. <u>Block Specifications</u>

1) <u>Block Diagrams</u>

a) CORRIDORBLOK

PNEXT	NRCORD
PABUSCOR	NOABVCR
PLHEX	PRHEX
PCHEX	NHWIDTH
PHLIST	PBDCNST
DEPTHLR (SPACE)	
ANGCORD (SPACE)	
ANGSPRD (SPACE)	
BUFRWDH (SPACE)	

b) CONSTBLOK

CORDSCOPE
YINTLBUF
YINTLCOR
YINTRCOR
YINTRBUF
XSPREAD
YSPREAD
ENTRYSLOPE
YLINENTRY
YENDCORD

c) HEXBLOK

ITOTAL	
PHEXY	NOLIST1
PHEX1	NOLIST2
PHEX3	NOLIST3
PHEX6	NOLIST4
PHEXUNK	NOLISTUNK

d) HEXLINK

PNEXT	HEX

e) ABVCR

PNEXT	PTRABSB
PACTAB	NOACTAB

f) ACTAB

PNEXT	NRACTYP
NOALOH	NOACASN

2) Field Definitions

a) CORRIDORBLOK BLOCK

PNEXT - Pointer to next CORRIDORBLOK block

NRCORD - Corridor Number.

PLHEX - Pointer to left corridor hex.

PRHEX - Pointer to right corridor hex.

PCHEX - Pointer to centerline corridor hex.

PBDCNST - Pointer to CONSTBLOK block.

PABVSCOR - Pointer to ABVCR block list.

NOABVCT - Number of ABVER blocks in the list.

PHLIST - Pointer to HEXBLOK block.

DEPTHCR - Depth of corridor, real variable.

ANGCORD - Angle of corridor, real azimth

ANGSPRD - Spread angle of corridor exit. real

BUFRWDH - Sam buffer zone width. real

b) CONSTBLOK BLODK

CORDSCLOPE - Corridor slope

YINTLBUF - Y intercept of buffer zone boundary-left.

YINTRCOR	-	Y intercept of corridor boundary-right.
YINTRBUF	-	Y intercept of buffer zone boundary - right
XSPREAD	-	X coordinate of exit spread lines.
YSPREAD	-	Y coordinate of exit spread lines.
ENTRYSLOPE	-	Slope of corridor center line.
YLINENTRY	-	Y intercept of corridor center line.
YENDCORD	-	Y intercept of corridor exit.

c) <u>HEXBLOK BLOCK</u>

ITOTAL	-	
PHEXY	-	Pointer to HEXLINK list (corridor left to corridor center)
NOLIST1	-	Number of (PHEX4) HEXLINK blocks in the list
PHEX1	-	Pointer to HEXLINK list (buffer left to corridor left)
NOLIST2	-	Number of (PHEX1) HEXLINK blocks in the list.
PHEX3	-	Pointer to HEXLINK list (corridor right to buffer right)
NOLIST3	-	Number of (PHEX3) HEXLINK blocks in the list.
PHEX6	-	Pointer to HEXLINK list (corridor center to corridor right)
NOLIST4	-	Number of (PHEX6) HEXLINK blocks in the list.
PHEXUNK	-	Number of HEXLINK list hexes between corridor ends)
NOLISTUNK	-	Number of (PHEXUNK) HEXLINK blocks in the list.

d) <u>HEXLINK BLOCK</u>

PNEXT	-	Pointer to next HEXLINK block in the list.
HEX	-	Pointer to HEX block (Note: could also be a nex number)

e) <u>ABVCR BLOCK</u>

PNEXT	-	Pointer to next ABVCR block in the list
PTRABSB	-	Pointer to airbase SB block
PACTAB	-	Pointer to ACTAB block
NOACTAB	-	Number of ACTAB blocks in the list

f) <u>ACTAB BLOCK</u>

PNEXT	-	Pointer to next ACTAB in the list
NRACTYP	-	Aircraft type code
NOACOH	-	Number of aircraft on hand
NOACASN	-	Number of aircraft assigned

e. <u>Linkages to other Data Structures</u>

The CORRIDOR DESCRIPTION LISTS are pointed to by a RAIDBLOK block which describes the raid in which the corridor is used.

f. <u>Notes</u>

Figure III-16 illustrates the relationship of HEXLINK lists to corridor boundaries.

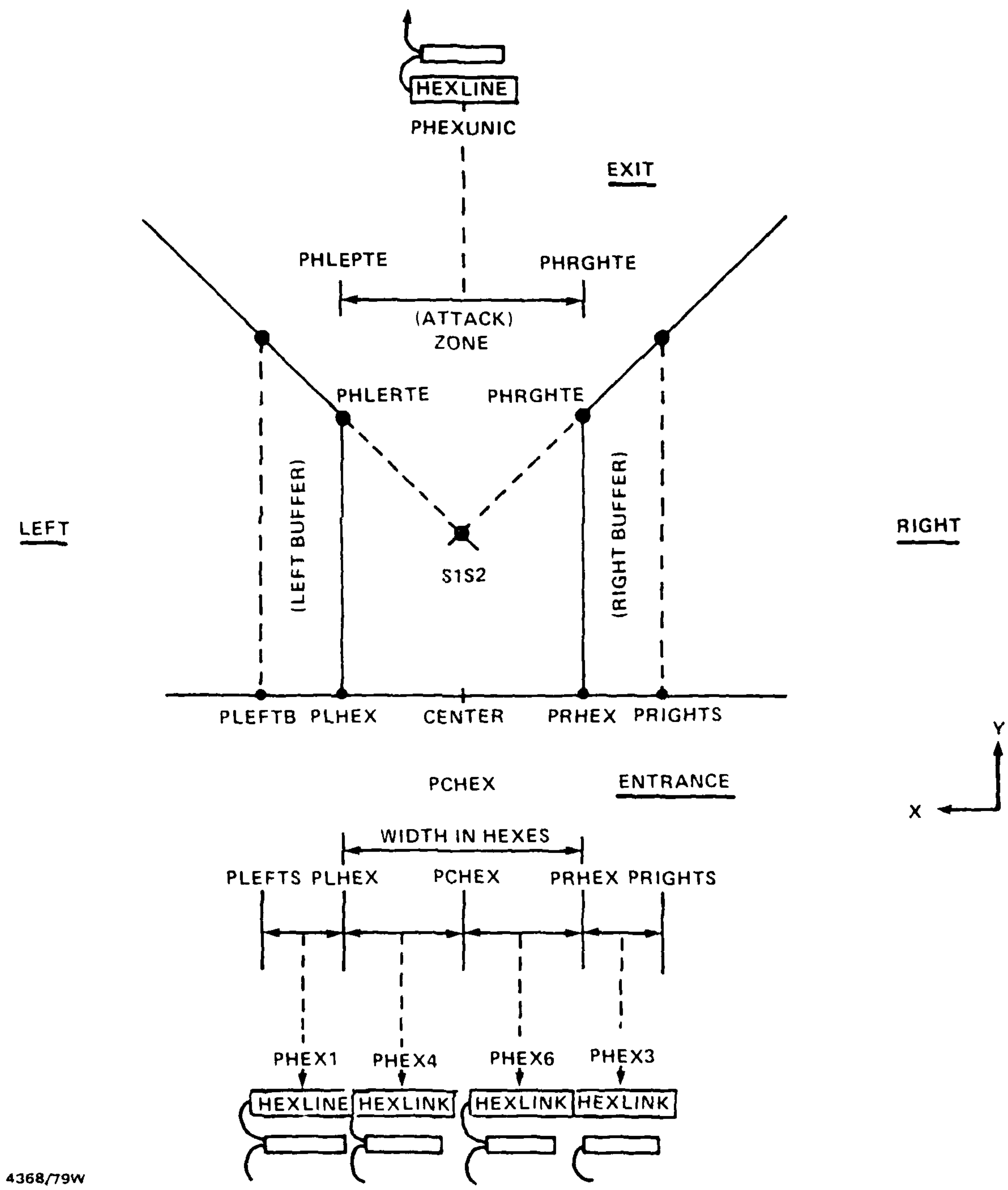


Figure III-16. Relationship of HEX LINK Lists To Corridor Boundaries

6. Attack Requirements/Allocations Lists

a. Data Block Index

ATTACKBLOK

ACTAB

COMMAND

FAKTGBLOK

FDBDBLOK

FLTAKTBLOK

FMFLTDB

FORMATIONBLOK

b. Description

The REQUIREMENTS LIST is used by the Red Theater Planner to specify the number and composition of formations required to attack targets of various types. Each TARGETBLOK block corresponds to a generic target type (e.g., airbase, boc, btry). FORMATIONBLOK blocks correspond to the formation types required for a target type. Each FORMATIONBLOK points to a FDBDBLOK block (formation data base) which in turn points to a list of FMFLTDB blocks (formation flight description) which point to FLTDB blocks (flight data base) for various types of flights. Each flight is homogeneous with respect to aircraft type. The aircraft for a flight must be assembled on a single air base. Partial flights cannot be launched. However, formations can be assembled from flights originating at multiple air bases. The formations required for each target type must be specified by the user for each raid via the UOL.

The ALLOCATIONS LIST parallels the REQUIREMENTS LIST. It corresponds to the actual allocation of aircraft resources to specific targets of the types specified in the TARGETBLOK blocks. The structure diagram illustrates this parallel structure. FKTGBLOK blocks (formation attacking target) in the ALLOCATIONS LIST correspond to the FORMATIONBLOK blocks in the REQUIREMENTS list. Similarly, FLTAKTBLOK blocks (flight attacking target) correspond to FMFLTDB blocks. It should be noted that all blocks indicated by an asterisk (*) are released after planning, the

only blocks which remain after planning are the database and command blocks required for subsequent operation of FLIGHTS created by the planning module.

c. Structure Overview

1) Structure Diagram (Figure III-17)

2) Block Definitions

REQUIREMENTS LIST DEFINITIONS - resource requirements for target types.

WAVEBLOK	-	WAVE DESCRIPTION BLOCK. Contains PTRS to next wave and TARGETBLOK list along with the wave number and the number of TARGETBLOK types in the list also contains the start time and duration of the wave.
TARGETBLOK	-	TARGET TYPE RESOURCE REQUIREMENTS BLOCK. Contains target type code, PTRS to formation and attackblok lists and the number of formations and attackbloks in each list. Also contains the maximum aircraft allocation for the TGT type, the number allocated, and the minimum and maximum attack radius.
FORMATIONBLOK	-	FORMATION DESCRIPTION BLOCK. Contains PTRS to next FORMATION BLOCK and to FDBDBLOK as well as the number of formations required and assigned
FDBDBLOK	-	FORMATION DATA BASE BLOCK. Contains basic formation type specifications including pointer to flight data base list (FMFLTDB).
FMFLTDB	-	FORMATION COMPONENT FLIGHT DATA BLOCK. Contains PTR to FLTDB flight data base block for a flight attached to the formation.

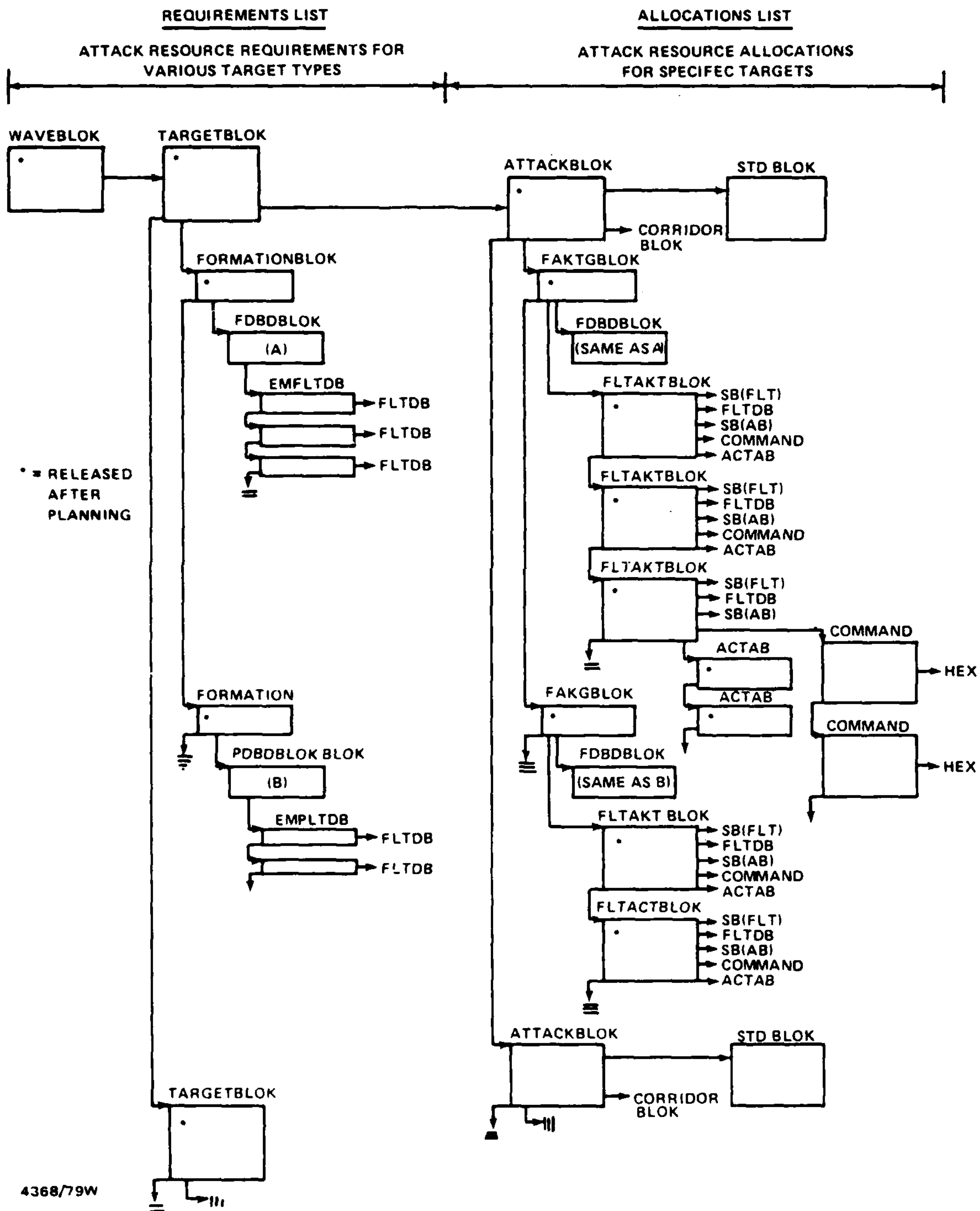


Figure III-17. Attack Requirements/Allocations List Structure Diagram

ALLOCATIONS LIST DEFINITIONS - Resource Allocations for specific targets.

<u>ATTACKBLOK</u>- <u>SPECIFIC TARGET RESOURCE ALLOCATION BLOCK</u>. Contains PTRS to specific target description block (STDBLOK), formations attacking targetBlist (FAKTGBLOK) and the CORRIDOR block for the corridor through which the attack will take place. Also contains attack sector.

<u>FAKTGBLOK</u> - <u>FORMATIONS ATTACKING TARGET BLOCK</u>. Contains description of a formation assigned to attack the target. Contains PTRS to the FDBDBLOK described above, the next FAKTGBLOK attacking the TGT and a list of FLTAKTBLOK (flights attacking the TGT) which make up the formation. Also contains the number of FLTAKTBLOKS.

<u>FLTAKBLOK</u> - <u>FLIGHTS ATTACKING TARGET BLOCK</u>. Basic description of the flight, its composition, home base and orders.

<u>ACTAB</u> - <u>AIRCRAFT ON AIRBASE BLOCK</u>. Number of aircraft of the type specified in FLTAKTBLOK on hand and assigned at FLT's home base.

<u>COMMAND</u> - <u>COMMAND FOR ENTITY</u>. A list of up to six COMMAND blocks describes all of the actions which must be taken by the Red Flight in the course of its mission. Contains the action to be taken, a PTR to the hex address, and optionally the time at which the action is to occur.

d. <u>Block Specifications</u>

1) <u>Block Diagrams</u>

a) WAVEBLOK

PNEXT	NRWAVE
PTGTYPE	NOTGTYP
STARTIME (SPACE)	
DURATION (SPACE)	

b) TARGETBLOK

PNEXT	NRTGTYP
PTRFORM	NOFORM
PTGTATK	NOTGTAK
MAXACAL	NOACALC
MAXRHEX	NONRHEX

c) FORMATIONBLOK

PNEXT	PNXFRDB
NOFRMRQ	NOFRMAL

d) FDBDBLOK

PNEXT	NRFORM
PTRFLT	NOFLTL
SPFORMC	

e) FMFLTDB

PNEXT	PNXFLODB

f) ATTACKBLOK

PNEXT	PNXTGTL
PFMAKTC	NOFMAKT
ISECTOR	PNXTCRD

g) FAKTGBLOK

PNEXT	PNXFRDB
PFLTAKT	NOFLAKT

h) FLTAKTBLOK

PNEXT	PNXFLDB
NOACFLT	PFLABSB
PNXACAB	PTRFRAG
PFLTSB	

i) ACTAB

PNEXT	NRACTYP
NOACOH	NOACASN

j) COMMAND

PNEXT	NUMACTS
TMFLG	ADDRESS
TIME (SPACE)	
ACTION	

k) STDBLOK

PNEXT	PTGTSB
PTGTLTR	
PAMGPER (SPACE)	
PADRPER	

2) Field Definitions

a) WAVE Block

PNEXT	pointer to next WAVE block
NRWAVE	number of waves
PTGTYPE	pointer to TARGETBLOK
NOTGTYP	number of target types
STARTTIME	start time for wave
DURATION	duration of wave

b) TARGET Block

PNEXT	pointer to next target block
NRTGTYP	number of target types
PTRFORM	pointer to FORMATIONBLOK
NOFORM	number of formations
PRGTATK	pointer to ATTACKBLOK

NOTGTAK - number of attack blocks

MAXACAL - maximum AC allocations

NOACALC - number of AC allocations

MAXRHEX - maximum range in hexes at which the target can be attacked

MINRHEX - minimum range in hexes at which the target can be attacked

c) FORMATIONBLOK

PNEXT - pointer to next FORMATIONBLOK

NOFRMRQ - number of formation req.

NOFRMAL - actual number of formations

d) FDBDBLOK

PNEXT - pointer to next FDBDBLOK

NRFORM - formation number, must be unique

PTRFLT - pointer to formation flight data block (FMFLTDB)

NOFLTL - number of flights in the formation

SPFORMC - formation cruise speed in meters/ seconds

e) FMFLTDB

PNEXT - pointer to next formation flight block (FMFLTDB)

PNXFLDB - pointer to flight data block (FLTDB)

f) ATTACKBLOK

PNEXT - pointer to next ATTACKBLOK

PNXTGTL - pointer to STDBLOK

PFMAKTG - pointer to formation attacking target block (FAKTGBLOK)

NOFMAKT - number of formation attack blocks

ISECTOR - number of sector to be attacked, relative to attack corridor

PNXTCRD - pointer to corridor block (CORRIDORBLOK)

g) <u>FAKTGBLOK</u>

PNEXT	-	pointer to next formation attacking target block (FAKTGBLOK)
PNXFRDB	-	pointer to formation data base block (FDBDBLOK)
PFLTAKT	-	pointer to flight attacking target block (FLTAKTBLOK)
NOFLAKT	-	number of flights attacking target blocks

h) <u>FLTAKTBLOK</u>

PNEXT	-	pointer to next FLTAKTBLOK
PNXFLDB	-	pointer to FLTDB
NOACFLT	-	number of actual flights
PFLABSB	-	pointer to air base scoreboard
PNXACAB	-	pointer to aircraft on air base block (ACTAB)
PTRFRAG	-	pointer to COMMAND block
PFLTSB	-	pointer to flight scoreboard

i) <u>ACTAB</u>

PNEXT	-	pointer to next ACTAB
NRACTYP	-	aircraft type number
NOACOH	-	number of aircraft on hand
NOACASN	-	number of aircraft assigned

j) <u>COMMAND</u>

PNEXT	-	pointer to next COMMAND block
NUMACTS	-	number of the command
TMFLG	-	time flag, if 1 a time is associated with the command
ADDRESS	-	pointer to hex block for the command
TIME	-	time command is to be performed
ACTION	-	command or action code

k) <u>STD BLOK</u>

PNEXT	pointer to next STDBLOK
PTGTSB	pointer to target scoreboard
PTGTLTR	pointer to TGTPTREE
DAMGPER	perceived damage level
PADRPER	pointer to hex address

e. <u>Linkages to Other Data Structures</u>

The REQUIREMENTS LIST is pointed to by the WAVEBLOK block which is associated with the RED THEATER COMMANDER. The ATTACKBLOK block in the ALLOCATIONS LIST points to an STDBLOK block (specific target description block) in the Red theater commander's ASSIGNED TARGET LIST (also known as the Red theater commander perceptions list). Since these STDBLOK blocks are also in the POTENTIAL AND UNAVAILABLE TARGET LISTS, the allocations list is also connected to both the POTENTIAL AND UNAVAILABLE TARGETS LISTS.

f. <u>*Notes*</u>

7. RED AIR BASES

a. Data Block Index

ABINFO

ABQUEDB

ABSTATUS

ACOB

C2

QUEUES

QUESTAT

SB

b. Description

RED AIR BASE STRUCTURES are designed to keep track of the number and type of aircraft on the AIRBASE as well as the status of each aircraft type in terms of launch capability. The overall configuration of this structure is shown in the structure diagram.

c. Structure Overview

1) Structure Diagram (See Figure III-18)

2) Block Definitions

C2	-	COMMAND CONTROL BLOCK, contains unit NO, type and side, and C2 PTRS.
SB	-	SCOREBOARD BLOCK, contains Hex address, MR, unit ID, PTR to future event list for the unit, and ABSTATUS PTR.
SDB	-	STATUS DISPLAY BLOCK. Not used by AIRBASE.
ABSTATUS	-	AIR BASE STATUS BLOCK, contains PTRS to the AIRBASE information list (ABINFO) and the QUEUES list for each aircraft type on base. Also contains no of A/C on base and no of types of A/C on base.
ABINFO	-	AIRCRAFT ON BASE INFORMATION BLOCK. Contains aircraft type, no on hand and no in each service queue, and a PTR to A/C type's ACDB.

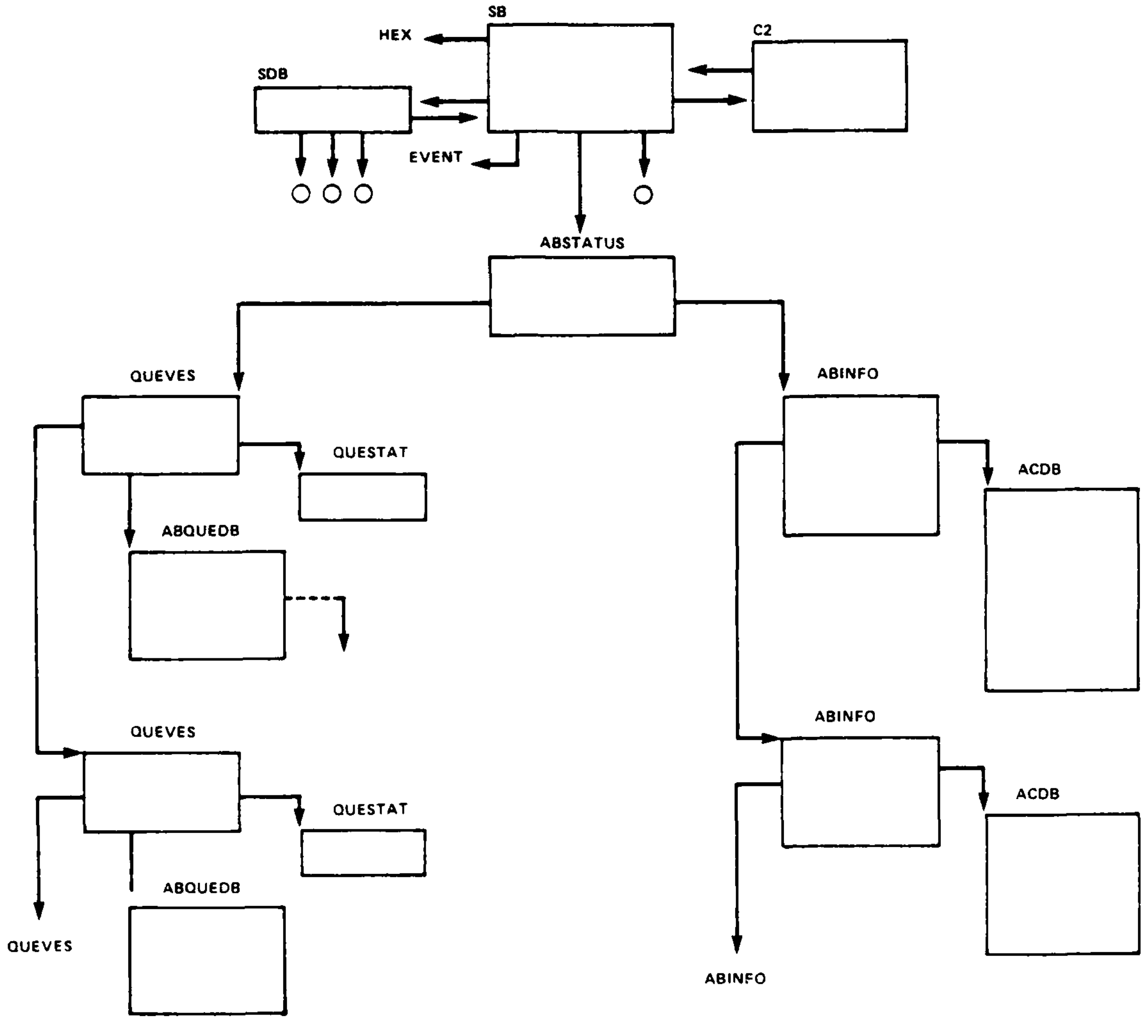


Figure III-18. Red Air Base Structure Diagram

4363/79W

QUEUES - AIRCRAFT SERVICE QUEUE BLOCK.

ABQUEDB - AIRBASE QUEUE DATA BASE BLOCK.

QUESTAT - QUEUE STATUS BLOCK.

ACDB - AIRCRAFT DATA BASE BLOCK. Operational parameters of A/C type.

d. Block Specification

1) Block Diagrams

a) C2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PABSTATUS

c) ABSTATUS

PACTAB	NOACTAB
PTR2QUES	NOACONAB
ABDAMAGE (SPACE)	

d) QUEUES

NEXT	QUENUM
PTR	NUMBER
PQDB	PQUESTAT

e) QUESTAT

VALUE (SPACE)

f) ABQUEDB

PNEXT	CLASS
VALUE1(SPACE)	
VALUE2(SPACE)	
VALUE3(SPACE)	

g) ABINFO

NEXT	NRACTYP
NOACOH	PTRACDB
NORMRQ	
NOREARMQ	
NOREFVELQ	
NOLAVNCHQ	

h) ACDB

NEXT	NRACTYPE
MAXSPEED (SPACE)	
CRUISESPEED (SPACE)	
MAXALTITUDE (SPACE)	
MINALTITUDE (SPACE)	
MAXCLIMBDIVE (SPACE)	
FUELCONSUME (SPACE)	
ACQRANGE (SPACE)	
RADARCS (SPACE)	
ATTACKRADIUS (SPACE)	
MAXFUEL (SPACE)	

2) Field Specifications

a) C2 Block

UNITNUMBER unit number

PUP pointer to C2 block of unit's commander

PDOWN pointer to C2 block of unit's subordinate

PSB pointer unit's SB block

PNEXT pointer to unit's sibling. C2 block

UNITTYPE unit type code (220)

SIDE unit affiliation 2 = Red (Pact)

b) <u>SB Block</u>

ADDRESS	pointer to <u>HEX</u> block in which unit is located
PC2	pointer to <u>C2</u> block of the unit
PSDB	pointer to SDB block (inactive)
PFEL	pointer to future event list for the unit
PACQ	pointer to acquisition devices
(inactive)	
ID	unit ED number
DATABASE	pointer to data base block (inactive)

c) <u>ABSTATUS Block</u>

PACTAB	pointer to <u>ABINFO</u> block
NOACTAB	number of <u>ABINFO</u> blocks in the list. Corresponds to number of aircraft on the base.
PTR2QUES	pointer to <u>QUEUES</u> block
NOACONAB	number of <u>QUEUES</u> blocks in the list. Corresponds to number of aircraft types on the base.
ABDAMAGE	damage level of base. Real variable.

d) <u>QUEUES Block</u>

NEXT	pointer to next <u>QUEUES</u> block in the list
QUENUM	<u>QUEUE</u> number. (2 = ready queue)
PTR	
NUMBER	
PQDB	pointer to <u>ABQUEDB</u> block
PQUESTAT	pointer to <u>QUESTAT</u> block

e) <u>QUESTAT Block</u>

VALUE	unknown. Real variable.

f) <u>ABQUEDB Block</u>

PNEXT	pointer to next <u>ABQUEDB</u> block
CLASS	aircraft class
VALUE1	
VALUE2 -	
VALUE3 -	

g) <u>ABINFO Block</u>

NEXT	pointer to next <u>ABINFO</u> block
NKACTYP	aircraft type code
NOACOH	number of aircraft of type (NRACTYP) on hand on the base
PTRACDB	pointer to <u>ACDB</u> for the aircraft type (NRACTYP)
NORMRQ	number in repair queue
NOREARMQ	number in rearm queue
NOREFUELQ	number in refuel queue
NOLAUNCHQ	number in launch queue

h) <u>ACDB Block</u>

NEXT	pointer to next <u>ACDB</u> block in data base (not used in this context)
NRACTYPE	aircraft type code
MAXSPEED	maximum speed. Real variable
CRUISESPEED	cruising speed. Real variable
MAXALTITUDE	maximum altitude. Real variable
MAXCLIMBDIVE	maximum rate of altitude change. Real variable
FUELCONSUME	Fuel consumption rate. Real variable
ACQRANGE	acquisition range. Real variable
RADARCS	radar cross-section. Real variable
ATTACKRADIUS -	maximum attack range of aircraft. Real variable
MAXFUEL	maximum fuel capacity. Real variable

e. <u>Linkages to Other Data Structures</u>

f. <u>Notes</u>

<u>QUEUES</u> blocks and their related lists are not used at present.

8. Red Flights

a. Data Block Index

ACDB

AQDB

ARCFSAW

ARCFTSTATUS

C2

COMMAND

FLTDB

FORMATION

LOAD

MUN

ORDERES

PAYDDBLOK

PAYLOAD

SB

SDB

SEEBUF

WINGMAN

b. Description

The Red Flight Data Structures control the actions of Red Flights. In addition to the three command/control blocks C^2, SB and SDB, Red Flights also use three lists. These lists include: the PERCEPTIONS LIST, the ORDERS LIST and the FLIGHT STATUS LIST.

The PERCEPTIONS LIST is composed of a buffer and a singly-linked list of ARCFSAW blocks. These ARCFSAW blocks contain information on Blue Targets perceived by the Red Flight. This information includes the location of the Blue Targets and its perceived damage level. When the Red Flight returns to its' airbase the perceived damage to Blue Target is transfered to the Red Theater Planner's STDBLOK blocks. Thus damage perception by Red Flights are transmitted to the Red Commander for subsequent planning activities.

The ORDERS LIST is composed of two buffered lists. The first is made-up of up to six COMMAND blocks which specify the actions to be taken by the flight at various points in its mission. These COMMAND blocks determine the flight geometry and mission profile for the flight. The second list is made up of WINGMAN blocks which contain pointers to the SR blocks of other flights in the other Red Flights in the formation.

The FLIGHT STATUS LIST consists of an ARCFTSTATUS block which tracks flight status and a set of two MUNITIONS LISTS which keep track of air-to-air and air-to-ground ordnance carried by the Red flight. The ARCFTSTATUS block points to an FLTOB block which is the core of a FLIGHT DATA BASE STRUCTURE. This structure is used as a template for construction of flights of specified types. It provides the basic aircraft characteristics and initial payload levels used to create and operate the FLIGHT.

Both the FLIGHT DATA STRUCTURES and the FLIGHT DATA BASE STRUCTURES are shown in the structure diagrams.

c. Structure Overview

1) Structure Diagrams (Figure III-19 & III-20)

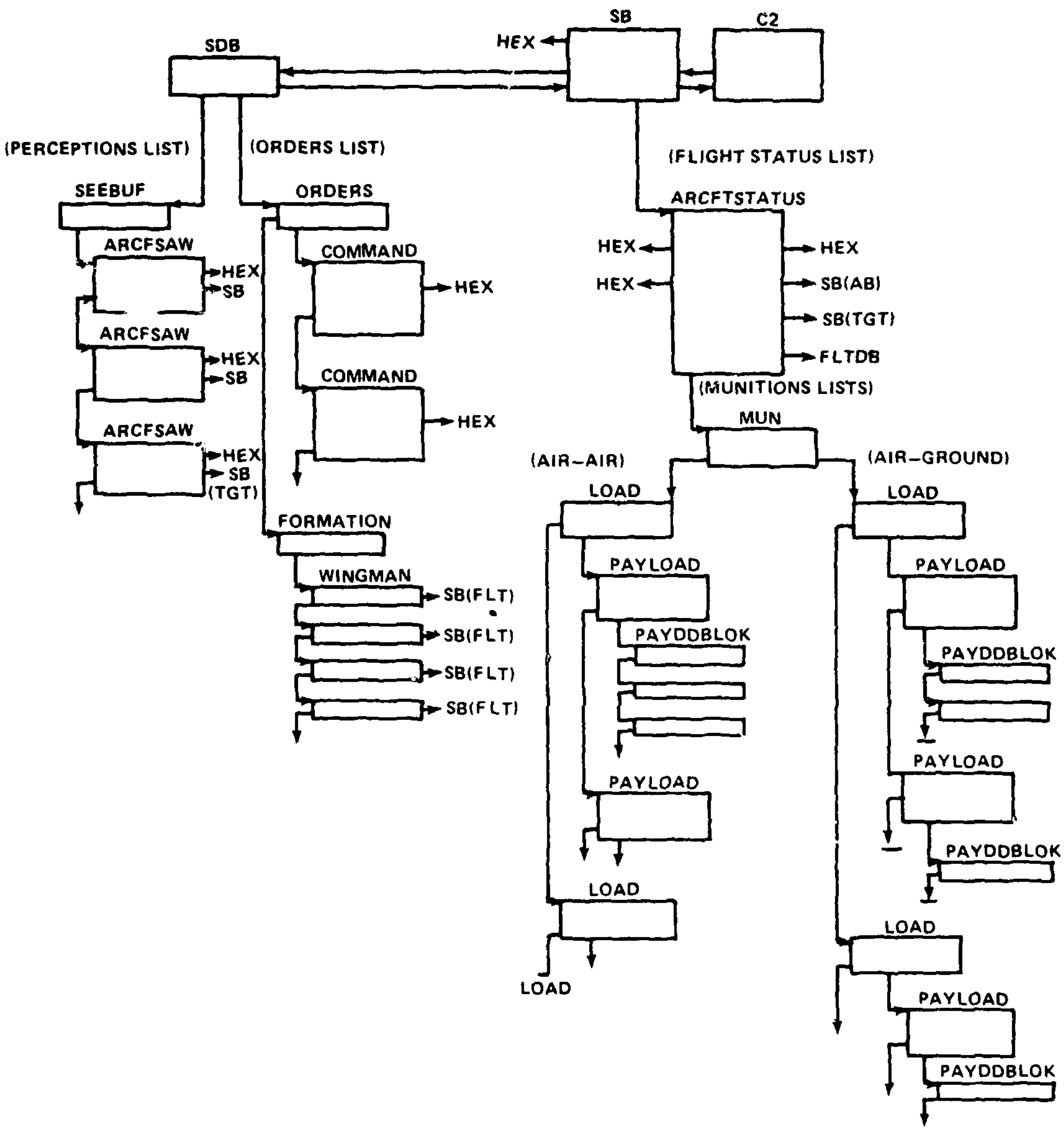
2) Block Definitions

a) COMMAND/CONTROL BLOCKS:

C^2 - COMMAND/CONTROL BLOCK. Contains unit no, type, side, and C^2 PTRS.

SB - SCOREBOARD BLOCK. Contains hex address, unit id, PTR to FEL and STAT.

SDB - STATUS DISPLAY BLOCK. Contains PTRS to perceptions list (SEEBUF) and orders list (ORDERS). Subordinate PTR not used by Red FLTS.



4368/79W

Figure III-19. Red Flight Structure Diagram

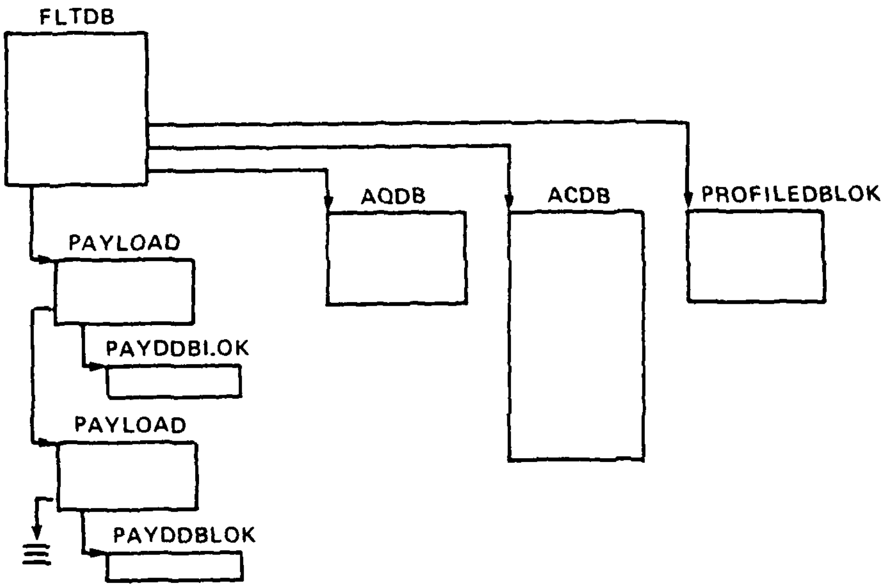


Figure III-20. Flight Data Base Structure Diagram

4368/79W

b) FLIGHT STATUS LIST

ARCFTSTATUS	-	FLIGHT STATUS BLOCK. Contains basic flight status information includes PTRS to starting, ending and next hex address in current move. Also includes PTRS to home base and TGT SB's, a status word, and current fuel, altitude, speed, and direction.
MUN	-	MUNITIONS LISTS BUFFER BLOCK. Buffer for air-to-air and air-to-ground munitions lists
PAYLOAD	-	PAYLOAD CLASS DESCRIPTION BLOCK. Basic payload parameters for class of ordinance. Contains class type, max and min amounts and max fire range. Also includes PTR to a list of attached ordnance types of the same class.
PAYDDBLOCK	-	PAYLOAD TYPE DATA BASE BLOCK. Contains PTR to next PAYDDBLOK and type of ordnance.
LOAD	-	PAYLOAD LIST BUFFER. Used to break payloads into types and keep track of ammunition load weight.

c) PERCEPTIONS LIST

SEEBUF	-	PERCEPTIONS LIST BUFFER BLOCK
ARCFSAW	-	AIRCRAFT PERCEPTION BLOCK. Contains information on entity perceived by a flight. Includes PTR to hex and SB of entity.

d) ORDERS LIST

ORDERS	-	ORDERS LIST BUFFER BLOCK. Contains no of orders remaining
COMMMAND	-	COMMAND DESCRIPTION BLOCK. Describes command to be followed by flight at specific address. Up to six in the list
FORMATION	-	FORMATION BUFFER BLOCK. Contains number of flts in the formation to which the flight belongs.
WINGMAN	-	WINGMAN LIST BLOCK. Contains PTR to other flts in the formation

3) FLIGHT DATA BASE

FLTDB	-	FLIGHT DATA BASE BLOCK. Contains basic flight description including No. of payloads, maximum no of A/C, minimum no. of A/C, and Multac, SPFLTC (SPACE, DISTSER(SPACE)
PAYLOAD	-	PAYLOAD DESCRIPTION BLOCK. Contains payload cla[illegible] (NRPDGLS) max and min amount of payload, and max fire range
PAYLDDBLOK	-	PAYLOAD TYPE BLOCK. Contains payload type index
AQDB	-	ACQUISITION DEVICE DATA BASE BLOCK. Contains type index and range of aquisition device.
ACDB	-	AIRCRAFT DATA BASE BLOCK. Contains A/C characteristics such as speed, max range, etc.

PROFILEDBLOK - MISSION PROFILE BLOCK. Contains flight altitude levels for three phases of mission - Alt. to corridor entrance, alt to tgt, and alt from tgt to air base.

d. Block Specifications

1) Block Diagrams

a) C^2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

b) SB

ADDRESS	PC^2
PACQ	ID
DATABASE	PABSTATUS
	+ PARCFTSTAT
	+ PBOCSTAT
	+ STATUS

c) SDB

PSB	PSEEBUF
+	PSEE
SUBORDINATE	ORD
+	PRAID

d) SEEBUF

PTRSEE	NUNITS

e) ARCFSAW

PNEXT	PSB
ADDRESS	TYPE
DAMAGE (SPACE)	

f) ORDERS

PTRFORMS	PTRACT

g) COMMAND

PNEXT	NVMACTS
TMFLG	ADDRESS
TIME (SPACE)	
ACTION	

h) FORMATION

PFORM	NUMFLTS

i) WINGMAN

PNEXT	PSB

j) AFCFTSTATUS

PFLTDB	PNUMITIONS
PSTRTHX	PENDHX
PNXTHX	PAIRBASE
CNTRLMODE	PAIRTGT
PGNOTDG	NUMAIRCRAFT
	DUMMY

JAMSTAT
GRNDATK
AIRCOMBAT
ORBITSTAT
LANDING
PROFILENOX
ALTUDECHNG
INTERCEPTSTATUS

FLITELEG

FUEL (SPACE)
ALTITUDE (SPACE)
SPEED (SPACE)
DIRECTION (SPACE)

k) MUN

PAG	NUMAG
PAA	NUMAA

l) LOAD

PNEXT	TYPE
AMOUNT	PORDDB

m) FLTDB

PNXFLDB	NRFLITE
PTYPLDS	NOPYLDS
PTYAQDB	PTACDB
MAXNOAC	MINNOAC
MULTAC	PROFILE
SPFLTC (SPACE)	
DISTSEP (SPACE)	

n) PAYLOAD

PNXTYPD	NRPDCLS
MAXAMT	MINAMT
MAXFIRE RANGE	PAYLDDB

o) PAYLLDBLOK

NEXT	TYPEINDEX

p) AQDB

NEXT	NRAQTYP
RANGE (SPACE)	
NOUSE 1	
NOUSE 2	

q) PROFILEDBLOK

PNXPRDB	NRPROFL
ALTCREN (SPACE)	
ALTOAB (SPACE)	

r) ACDB

NEXT NRACTYPE	
MAXSPEED (SPACE)	
CRUISESPEED (SPACE)	
MAXALTITUDE (SPACE)	
MINALTITUDE (SPACE)	

MAXCLIMBDIVE (SPACE)
FUELCONSUME (SPACE)
ACQRANGE (SPACE)
RADARCS (SPACE)
ATTACKRADIUS (SPACE)
MAXFUEL (SPACE)

2) Field Definitions

a) C^2 Block

UNITNUMBER - Number of the unit.

PUP - Pointer to the C^2 block of the unit's commander.

PDOWN - Pointer to the C^2 block of the unit's subordinate.

PNEXT - Pointer to the C^2 block of the unit's sibling.

PSB - Pointer to the SB block of the unit.

UNITTYPE - The unit's type code (128)

SIDE - Unit Affiliation. 2 - Red (PACT)

b) SB Block

ADDRESS - Pointer to HEX block of the HEX in which the unit is located.

PL2 - Pointer to C^2 block of the unit.

PSDB - Pointer to the SDB block of the unit.

PFEL - Pointer to future event list EVENT block.

PACQ - Pointer to ACQBUF block. Used by CRC's for acquisition devices.

ID	-	Identification number
DATABASE	-	If BOC or BTRY points to ADSITEDB block.
PABSTATUS	-	Points to ABSTATUS block if the unit is an air base.
+PARCFTSTAT	-	Points to ARCFSTATUS block if the unit is a flight of aircraft.
+PDOCSTAT	-	Points to BOCSTAT block if the unit is a battalion operations center.
+PBTRYSTAT	-	Points to BTRYSTAT block if the unit is an antiaircraft battery.
+STATUS	-	Alternative field definition.

c) <u>SDB Block</u>

PSB	-	Pointer to the unit's SB block.
PSEEBUF	-	Pointer to SEEBUF block which is is used only by flights.
+PSEE	-	Pointer to CRCEES block which is used by CRC units to record the blue and red flights it sees. Also used by the BIC as a pointer to its assigned target block. TARGETLISTBLOK.
SUBORDINATE	-	Points to different types of subordinate description or target description blocks depending upon the unit type. Possible unit type vs. field use combination are as follows:

UNIT TYPE	SUBCRDINATE POINTS TO
CRC	SUB
BOC	SUBLIST
BTRY	FIREUNIT

ORD	-	Points to ORDERS block if the unit is a flight.

+PRAID - Points to the RAIDBLOK if the unit is the Red Theater Commander.

d) <u>SEEBUF BLOCK</u>

PTRSEE - Pointer to ARCFSAW block. (first in list)

NUNITS - Number of ARCFSAW blocks in the list. Corresponds to number of targets perceived.

e) <u>ARCFSAW BLOCK</u>

PNEXT - Pointer to next ARCFSAW block in the list.

PSB - Pointer to SB block of target.

ADDRESS - Pointer to HEX block in which target is located.

TYPE Unit type code of target.

DAMAGE - Perceived damage level of the target. Real variable.

f) <u>ORDERS BLOCK</u>

PTRFORMS - Pointer to FORMATION block.

PTRACT - Pointer to COMMAND block.

g) <u>COMMAND BLOCK</u>

PNEXT - Pointer to next command block

NUMACTS - Number of the command in the list.

TMFLG - Time flag. If 1 at time is associated with the command.

ADDRESS - Pointer to HEX block in which the command is to be carried out.

TIME - Time the command is to be performed.

ACTION - Command or action code.

h) <u>FORMATION BLOCK</u>

PFORM - Pointer to first WINGMAN block in the list.

NUMFLTS - Number of WINGMAN blocks in the list. Corresponds to number of flights in the formation.

i) <u>WINGMAN BLOCK</u>

PNEXT - Pointer to next WINGMAN block in the list.

PSB - Pointer to the SB block of the flight.

j) <u>*ARCFTSTATUS BLOCK*</u>

PFLTDB - Pointer to FLTDB block

PMUNITIONS - Pointer to NUM block

PSTRTHX - Pointer to HEX block in which current move begins

PENDHX - Pointer to HEX block in which current move ends

PNXTHX - Pointer to next HEX block

PAIRBASE - Pointer to SB block of flight's home air base.

CNTRLMODE -

PAIRTGT - Pointer to SB block of airborn target.

PGNDTGT - Pointer to SB block of ground target.

NVMAIRCRAFT - Number of aircraft in the flight.

FLITELEG

INTERCEPTSTATUS

ALTUDCHNG

PROFILENDX

LANDING

ORBITSTAT

AIRCOMBAT

JAMSTAT

FUEL - Current fuel level. Real variable

ALTITUDE	-	Altitude in meters. Real variable
SPEED	-	Speed. Real variable
DIRECTION	-	Direction. Real variable

k) MUM BLOCK

PAG	-	Pointer to ground attack LOAD block
NUMAG	-	Number of LOAD blocks in ground attack munitions list
PAA	-	Pointer to air attack LOAD block
NUMAA	-	Number of LOAD blocks in air attack numitions list

l) LOAD BLOCK

PNEXT	-	Pointer to next LOAD block in the list
TYPE	-	Munitions class
AMOUNT	-	Amount of munitions in tons
PORDDB	-	Pointer to PAYLOAD block

m) FLTDB BLOCK

PBXFLDB	-	Pointer to next FLTDB block
NRFLITE	-	Unique flight specification number
PTYPLDS	-	Pointer to PAYLOAD data block Payload class 6002
NOPYLDS	-	Number of PAYLOAD data blocks
PTYAQDB	-	Pointer to ACQUISITION data block (AQDB), Class 6007)
PTACDB	-	Pointer to aircraft specification data block (ACDB, CLASS 6003)
MAXNOAC	-	Maximum number of aircraft in flight
MINNOAC	-	Minimum number of aircraft in flight
MULTAC	-	Multiples of aircraft required for flight
PROFILE	-	Pointer to profile specification data block (Profiled blok, class 6005)

SPFLTC(SPACE)		Flight crusing speed in meters/second (real)
DISTSEP(SPACE)		Flight separation distance in meters (real)

n) PAYLOAD BLOCK

PNXTYPD	-	Pointer to next payload block
NRPDCLS	-	Payload type, must be 3 or 4 3 = air-to-ground 4 = air-to-air
MAXAMT	-	Maximum number of loads of this payload
MINAMT	-	minimum number of loads of this payload
MAXFIRERANGE		Future use by an enhancement for maximum fire range for engagements greater than one hex
PAYLODB	-	Pointer to payload ID data block (PAYLODBLOK)

o) PAYLODBLOK BLOCK

NEXT	-	Pointer to next ID block
TYPEINDEX	-	Payload ID, unique within each payload type

p) AQDB BLOCK

NEXT	-	Pointer to next AQDB block
NRAQTYP	-	Unit type
RANGE(SPACE)		Acquisition range in meters (real)
NOUSE1	-	Not used
NOUSE2	-	Not used

q) PROFILEDBLOK BLOCK

PNXPRDB	-	Pointer to next PROFILEDBLOK
NRPROFL	-	Profile identification number, must be unique within the 6005 class

ALTCREN	-	Altitude of first leg in meters (real)
ALTOTGT	-	Altitude of second leg in meters (real)
ALTOAB	-	Altitude of third leg in meters (real)

r) <u>ACDB BLOCK</u>

NEXT	-	Pointer to next ACDB block
NRACTYPE	-	Aircraft type number
MAXSPEED	-	Maximum speed in meters/second (real)
CRUISESPEED		Cruising speed in meters/second (real)
MAXALTITUDE		Maximum altitude in meters (real)
MINALTITUDE		Minimum altitude in meters (real)
MAXCLIMBDIVE		Maximum climb/dive rate in meters/ seconds (real)
FUELCONSUME		Fuel consumption rate in hexes/second (real)
ACQRANGE	-	Acquisition range in meters (real)
RADARCS	-	Radar cross sections in hexes (real)
ATTACKRADIUS		Attack radius in meters (real)
MAXFUEL	-	Maximum fuel load in hexes (real)

e. <u>Linkages to Other Data Structures</u>

f. <u>Notes</u>

G. BLUE STRUCTURES

In contrast to Red Structures which are dominated by threat planning related structures, Blue Structures are all related to some type of combat entity or player. Seven of those player types are connected to the BLUE C^2 tree, while the eight is connected to the passive target list.

1. ALLIED TACTICAL AIR FORCE (ATAF)

a. DATA BLOCK INDEX

C2

SB

SND

b. DESCRIPTION

The ALLIED TACTICAL AIR FORCE structure resides at the top of the blue C2 TREE (see E.2.f). It is currently used only to maintain the consistency of the blue command/control structure and does not initiate actions in the course of the simulation.

c. STRUCTURE OVERVIEW

1) STRUCTURE DIAGRAM (Figure III-21)

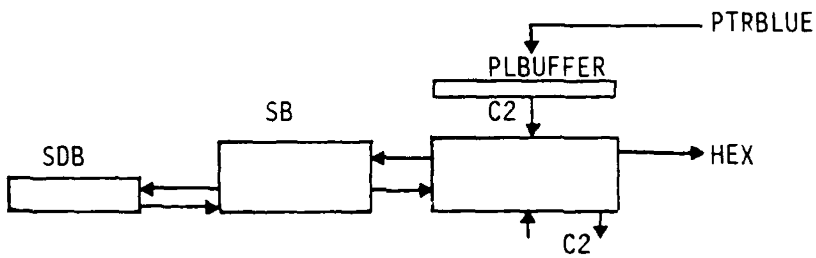


Figure III-21. Allied Tactical Air Force Structure Diagram

2) BLOCK DEFINITIONS

PLBUFFER	-	C2 TREE BUFFER BLOCK. Contains pointer to the tree and the side of the tree
C2	-	COMMAND/CONTROL BLOCK. Contains tree pointers, unit number, pointer to scoreboard (SB), unit type code and side
SB	-	SCOREBOARD BLOCK. Contains pointers to C2 and HEX blocks, and the status display board (SDB). Also contains pointers

to acquisition devices, various unit status blocks and the future event list. Use varied with unit type.

<u>SDB</u> - <u>STATUS DISPLAY BOARD BLOCK</u>. Contains subordinate, acquisition and order pointers. Use varies with unit type

d. <u>BLOCK SPECIFICATIONS</u>

1) PLBUFFER

PTRPL	VARIWORD

2) C2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITYPE	SIDE

NOTE: + ALTERNATE DEFINITION OF FIELD

3) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PABSTATUS
+	PARCFTSTAT
+	PBOCSTAT
+	PBTRYSTAT
+	STATUS

4) SDB

PSB	PSEEBUF
+	PSEE
SUBORDINATE	ORD
+	PRAID

e. FIELD DEFINITIONS

1) PLBUFFER BLOCK

PTRPL	-	Pointer to C2 Block
VARWORD	-	Side indicator for tree 1 = BLUE (NATO) 2 = RED (PACT)

2) C2 BLOCK

	-	Number of the unit. If negative, the unit is a passive target
PUP	-	Pointer to the C2 block of the unit's commander
PDOWN	-	Pointer to the C2 block of the unit's sibling
PSB	-	Pointer to the SB block of the unit
UNITTYPE	-	The unit's type code (see subsection 6).
SIDE	-	Unit affiliation 1 = BLUE (NATO) 2 = RED (PACT)

3) SB BLOCK

ADDRESS	-	Pointer to HEX block of the hex in which the unit is located
PC2	-	Pointer to C2 block of the unit
PSDB	-	Pointer to the SDB block of the unit
PFEL	-	Pointer to future event list EVENT block
PACQ	-	Pointer to ACQBUF block. Used by CRC's for acquisition devices

ID	-	Identification number
DATABASE	-	If BOC or BTRY points to ADSITEDB block
PABSTATUS	-	Points to ABSTATUS block if the unit is an airbase
+PARCFTSTAT	-	Points to ARCFTSTATUS block if the unit is a flight or aircraft.
+PBOCSTAT	-	Points to BOCSTAT block if the unit is a battalion operations center
TPBTRYSTAT	-	Points to BTRYSTAT clock if the unit is an anti-aircraft battery
+STATUS	-	alternative field definition

4) SDB BLOCK

PSB	-	Pointer to the unit's SB block
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their perceived damage levels. This field definition is used only by flights
+PSEE	-	Pointer to CRCEES block which is used by CRC units to record the blue and red flights it sees. Also used by the RTC to point to its' assigned target list. TARGET LISTBOOK

SUBORDINATE	-	Points to different types of subordinate description or target description blocks depending upon the unit type. Possible unit type vs field use combinations are as follows:

UNIT TYPE	SUBORDINATE POINTS TO
CRC	SUB
BOC	SVBUST
BTRY	FIREUNIT

ORD	-	Points to ORDERS block if the unit is a flight
+PRAID	-	Points to the RAIDBLOK if the unit is the Red theater commander

2. SECTOR OPERATIONS CENTERS (SOC)

a. DATA BLOCK INDEX

C2

SB

SDB

b. DESCRIPTION

The SECTOR OPERATIONS CENTER structures reside on the Blue C2 tree on the Blue C2 tree on the level below the ATAF. Like the ATAF, they are currently used only to maintain the consistency of the Blue command/control structure. SOC's do not initiate actions in the course of the simulation.

c. STRUCTURE OVERVIEW

1) STRUCTURE DIAGRAM (Figure III-22)

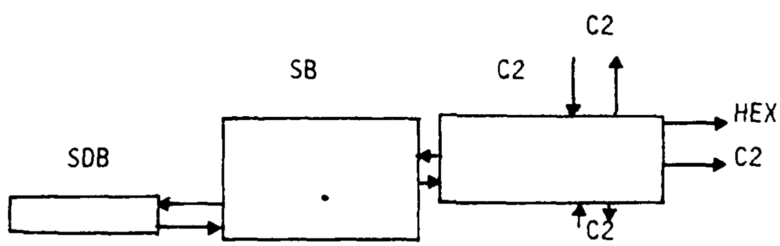


Figure III-22. Sector Operations Center Structure Diagram

2) BLOCK DEFINITIONS

PLBUFFER - C2 Tree Buffer Block. Contains pointer to the tree and to the side of the tree

C2 - Command/Control Block. Contains tree Pointers, unit number, pointer to scoreboard (SB), unit type code and side

SB - Scoreboard Block. Contains pointers to C2 and HEX blocks, and the status display board (SDB). Also contains pointers to acquisition devices, various unit status blocks and the future EVENT list. Use varies with

unit type

SDR - Status Display Board Block. Contains subordinate, acquisition and order pointers. Use varies with unit type

d. BLOCK SPECIFICATIONS

1) BLOCK DIAGRAMS

a) C2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITYPE	SIDE

NOTE: + ALTERNATE DEFINITION OF FIELD

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PABSTATUS
+	PARCFTSTAT
+	PBOCSTAT
+	PBTRYSTAT
+	STATUS

c) SDB

PSB	PSEEBUF
+	PSEE
SUBORDINATE	ORD
+	PRAID

2) FIELD DEFINITIONS

a) C2 BLOCK

UNITNUMBER	-	Number of the unit. If negative, the unit is a passive target
PVP	-	Pointer to the C2 block of the unit's commander
PDOWN	-	Pointer to the C2 block of the units's subordinate
PNEXT	-	Pointer to the C2 block of the unit's sibling
PSB	-	Pointer to the SB block of the unit
UNITYPE	-	The unit's type code (see subsection 5))
SIDE	-	Unit affiation 1 = BLUE (NATO) 2 = RED (PACT)

b) SB BLOCK

ADDRESS	-	Pointer to HEX bock of the hex in which the unit is located
PC2	-	Pointer to C2 block of the unit
PSDB	-	Pointer to the SDB block of the unit
PFEL	-	Pointer to future event list EVENT block
PACQ	-	Pointer to ACQBUF block. Used by SRC's for acquisition devices.
ID	-	Identification number

DATABASE	-	If BOC or BTRY points to ADSITEDB block
PABSTATUS	-	Points to ABSTATUS block if the unit is an airbase
+PARCFTSTAT	-	Points to ARCFTSTATUS block if the unit is a flight of aircraft
+PBOCSTAT	-	Points to BOCSTAT block if the unit is a battalion operation center
+PBTRYSTAT	-	Points to BTRYSTAT block if the unit is an antiaircraft battery
+STATUS	-	Alternative field definition

c) SDB BLOCK

PSB	-	Pointer to the unit's SB block
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their perceived dmamage levels. This field definition is used only by flights.
+PSEE	-	Pointer to CRCEES block which is used by CRC units to record the blue and red flights it sees. Also used by the RTC to point to its' assigned target list. TARGET LIST BLOCK

SUBORDINATE - Points to different types of subordinate description or target description blocks depending upon the unit type. Possible unit type vs vield use combinations are as follows:

UNIT TYPE	SUBORDINATE POINTS TO
CRC	SUB
BOC	SUBLIST
BTRY	FIREUNIT

ORD - Points to ODERS block if the unit is a flight

+ PRAID - Points to the RAIDBLOK if the unit is the Red theater commander

e. LINEAGES TO OTHER DATA STRUCTURES

Pointer to HEX block in which unit is located

f. NOTES

3. COMBAT REPORTING CENTERS (CRC)

a. DATA BLOCK INDEX

ACQBUF

ACQDEVICE

C2

CACSEEBLUE

CRCSEERED

CRCSEES

CRCSUBORD

SB

SDB

SEER

SUB

SUBTYPE

b. Description

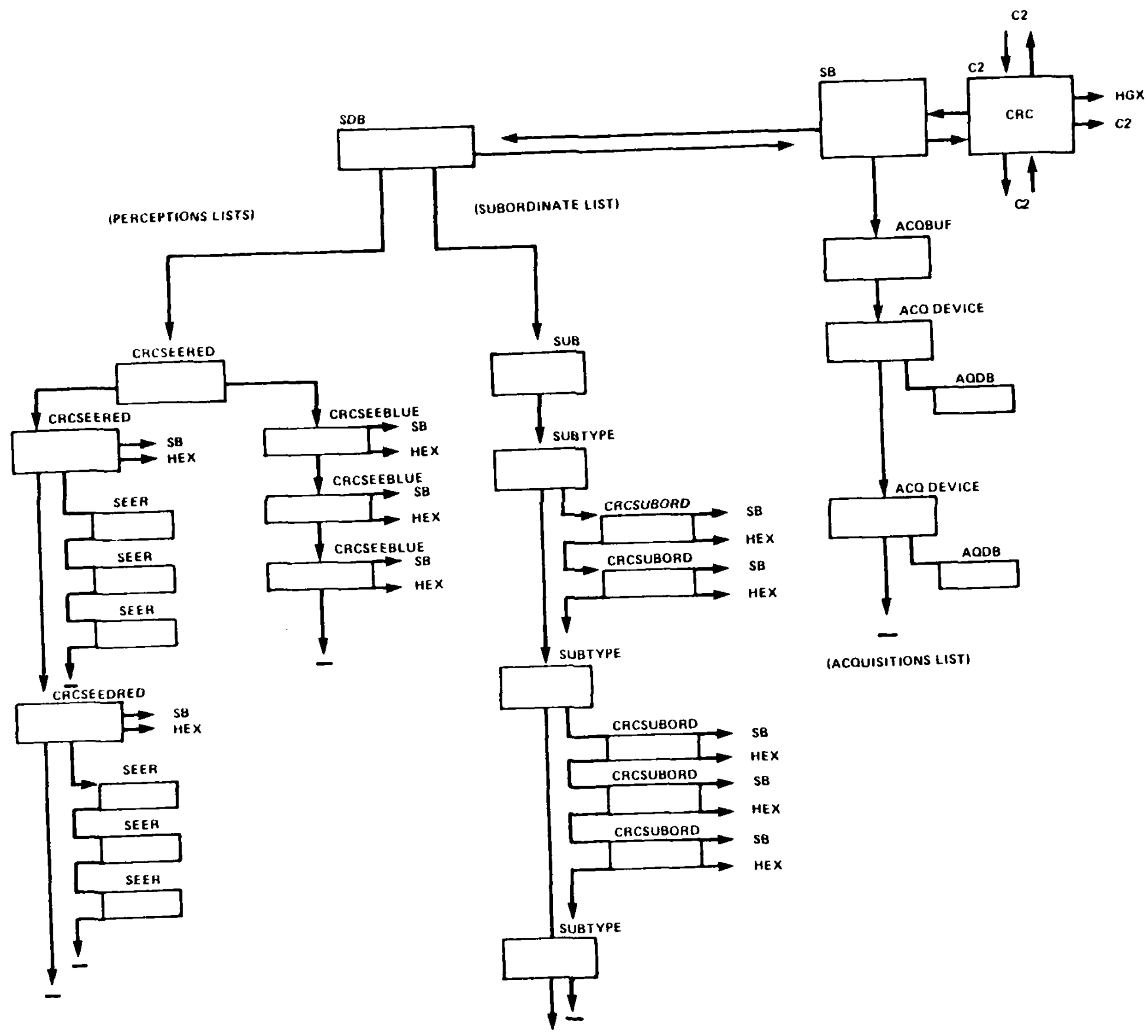
The COMBAT REPORTING CENTERS are the highest ranking active players on the Blue side. In addition to the basic command control structures (C^2, SB and SDB), CRC's posess three unique lists - the PERCEPTIONS LIST, the SUBORDINATE LIST, and the ACQUISITION LIST.

The ACQUISITION LIST is used to keep track of acquisition devices belonging to the CRC. The SUBORDINATE LIST is used to keep track of the CRC's subordinate blue units (including FLIGHTS). These lists are stratified by device and subordinate type respectively.

The PERCEPTION LIST consists of two branches. One keeps track of Red Units and the Blue Units perceiving them. The other keeps track of Blue Units perceived by the CRC directly. It is important to note that the CRC may perceive enemy units through its subordinates. The overall configuration of the CRC structure is shown in the structure diagram.

c. Structure Overview

1) Structure Diagram (Figure III-23)



4368/79W

Figure III-23. Combat Reporting Center Structure Diagram

2) Block Definitions

$\underline{C^2}$	-	COMMAND/CONTROL BLOCK. Contains tree pointers, unit number, pointer to scoreboard (SB), unit type code and side.
SB	-	SCOREBOARD BLOCK. Contains pointers to C^2 and HEX blocks, and the status display board (SDB). Also contains pointers to acquisition devices various unit status blocks and the future event list. Use varies with unit type.
SDB	-	STATUS DISPLAY BOARD BLOCK. Contains subordinate, acquisition and order pointers. Use varies with unit type.
ACQBUF	-	ACQUISITION DEVICE LIST BUFFER. Contains a pointer to the device list and the number of devices (ACQDEVICE BLOCKS) in the list.
ACQDEVICE	-	ACQUISITION DEVICE DESCRIPTION BLOCK. Contains device code, operating status and a pointer to the next ACQDEVICE block in the list.
AQDB	-	ACQUISITION DEVICE DATA BASE BLOCK. Basic data on specific acquisition device.
SUB	-	SUBORDINATE LIST BUFFER. Contains a pointer to the subordinate list and the number of subordinate types (SUBTYPE BLOCKS) in the list.

<u>SUBTYPE</u>	-	<u>SUBORDINATE TYPE BLOCK</u>. Contains a subordinate type code, the number of subordinates of that type, a pointer to the next SUBTYPE and a pointer to a list of specific subordinate unit blocks (CRCSUBORD).
<u>CRCSUBORD</u>	-	<u>CRC SUBORDINATE BLOCK</u>. Contains unit ID of the subordinate, a pointer to its SB block and HEX block, and a pointer to the next CRCSUBORD block in the list.
<u>CRCSEES</u>	-	<u>CRC PERCEPTIONS LIST BUFFER BLOCK</u>. Contains pointers to Red and Blue branches and the number of units (CRCSEERED and CRCSEEBLUE BLOCKS) in each branch.
<u>CRCSEERED</u>	-	<u>RED UNIT PERCEIVED BLOCK</u>. Contains a description of Red Unit perceived. Includes pointers to its' SB and HEX blocks as well as its' direction of movement. Also contains a pointer to a list of Blue units which can see it.
<u>SEER</u>	-	<u>BLUE PERCEPTION UNIT BLOCK</u>. Contains unit ID of the Blue Unit perceiving a Red Unit.
<u>CRCSEEBLUE</u>	-	<u>BLUE UNIT PERCEIVED BLOCK</u>. Contains the unit ID, SB and HEX block pointers of a Blue Unit perceived by the CRC.

d. Block Specifications

1) Block Diagrams

a) C^2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

Note: + Alternate Definition of field.

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PABSTATUS
+	PARCFTSTAT
+	PBOCSTAT
+	PBTRYSTAT
+	STATUS

c) SDB

PSB	PSEEBUF
+	PSEE
SUBORDINATE	ORD
+	PRAID

d) ACQBUF

PTRACQ	NUMDEV

e) ACQDEVICE

PNEXT	TYPE
WORKING	PACQDB
JAM	LEVEL

f) AQDB

NEXT	NRAQTYP
RANGE(SPACE)	
NOUSE1	
NOUSE2	

g) SUB

PSUB	NUMBER

h) SUBTYPE

PNEXT	TYPE
PTRSUB	NUMBER

i) CRCSUBORD

PNEXT	ID
PSB	ADDRESS
WORD 1	WORD 2

j) CRCSEES

REDSEE	NUMBERD
BLUESEE	NUMBLUE

k) CRCSEERED

PNEXT	ID
PSB	ADDRESS
RPT	HUNTER
DIRECTION (SPACE)	
PNX	NUMSEE

l) SEER

PNEXT	ID

m) CRCSEEBLUE

PNEXT	ID
PSB	ADDRESS

2) FIELD DEFINITIONS

a) C^2 BLOCK

UNITNUMBER - Number of the unit. If negative the unit is a passing target.

PVP - Pointer to the C^2 block of the unit's commander.

PDOWN - Pointer to the C^2 block of the unit's subordinate.

PNEXT	-	Pointer to the $\underline{C}^2$ block of the unit's commander.
PSB	-	Pointer to the SB block of the unit
UNITTYPE	-	The unit's type code (see subsection f)
SIDE	-	Unit affiliation. 1 = Blue (NATO) 2 = Red (PACT)

b) <u>SB BLOCK</u>

ADDRESS	-	Pointer to HEX block of the HEX in which the unit is located.
PC2	-	Pointer to C^2 block of the unit
PSDB	-	Pointer to the SDB block of the unit
PFEL	-	Pointer to future event list EVENT BLOCK.
PACQ	-	Pointer to ACQBUF BLOCK. Used by CRC's for acquisition devices.
ID	-	Identification number
DATABASE	-	If BOC or BTRY points to ADSITEDB block
PABSTATUS	-	Points to ABSTATUS block if the unit is an airbase
+PARCFTSTAT	-	Points to ARCFTSTATUS block if the unit is a flight of aircraft.
+PBOCSTAT	-	Points to BOCSTAT block if the unit is a battalion operations center
+PBTRYSTAT	-	Points to BTRYSTAT block if the unit is an anti-aircraft battery

+STATUS	-	Alternative field definition
+PBTRYSTAT	-	Points to BOCSTAT block if the unit is an anti-aircraft
+STATUS	-	Alternative field definition.

c) <u>SDB BLOCK</u>

PSB	-	Pointer to the unit's SB block.
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their perceived damage levels. This field definition is used only by flights.
+PSEE	-	Pointer to CRCEES block which is used by CRC units to record the Blue and Red flights it sees. Also used by RTC to point to its' assigned targets list
SUBORDINATE	-	Points to different types of subordinate description or target description blocks depending upon the unit type. Possible unit type vs. field use combinations are as follows:

UNIT TYPE	SUBORDINATE POINTS TO
CRC	SUB
BOC	SUBLIST
BTRY	FIREUNIT

ORD	-	Points to ORDERS block if the unit is a flight
+PRAID	-	Points to RAIDBLOK if the unit is the Red Theater Commander.

d) <u>ACQBUF BLOCK</u>

PTRACQ	-	Pointer to ACQDEVICE block.
NUMDEV	-	Number of ACQDEVICE blocks in the lst.

e) <u>ACQDEVICE BLOCK</u>

PNEXT	-	Pointer to the next ACQDEVIDE block in the list.
TYPE	-	Acquisition device type code
WORKING	-	
PACQDB	-	Pointer to ACDB block.
JAM	-	
LEVEL	-	

f) <u>AQDB BLOCK</u>

NEXT	-	Pointer to next AQDB block in data base
NRAQTYP	-	Acquisition device type code
RANGE	-	Range of devide. *Real variable*
NOUSE1	-	
NOUSE2	-	

g) <u>SUB BLOCK</u>

PSUB	-	Pointer to SUBTYPE block
NUMBER	-	Number of SUBTYPE blocks in the list

h) <u>SUBTYPE BLOCK</u>

PNEXT	-	Pointer to next SUBTYPE block
TYPE	-	Subordinate type code
PTRSUB	-	Pointer to CRCSUBORD block
NUMBER	-	Number of CRCSUBORD blocks in the list

i) <u>CRCSUBORD BLOCK</u>

PNEXT	-	Pointer to next CRCSUBORD block
ID	-	Unit ID

PSB	-	Pointer to Unit's SB block
ADDRESS	-	Pointer to Unit's HEX block.
WORD1	-	
WORD2	-	

j) CRCEES BLOCK

REDSEE	-	Pointer to CRCSEERED block
NUMRED	-	Number of CRCSEERED blccks in the list.
BLUESEE	-	Pointer to CRCSEEBLUE blocks
NUMBLUE	-	Number of CRCSEEBLUE blocks in the list.

k) CRCSEERED BLOCK

PNEXT	-	Pointer to next CRCSEERED block
ID	-	Unit ID.
PSB	-	Pointer to Red Unit's SB block
ADDRESS	-	Pointer to Red Unit's HEX block
RPT	-	
HUNTER	-	
DIRECTION	-	Direction of travel, real variable
PNX	-	Pointer to SEER block
NUMSEE	-	Number of SEER blocks in the list

l) SEER BLOCK

PNEXT	-	Pointer to next SEER block
ID	-	Unit ID of Blue perceiver

m) CRCSEEBLUE BLOCK

PNEXT	-	Pointer to next CRCSEEBLUE block
ID	-	Unit ID
PSP	-	Pointer to Unit's SB block
ADDRESS	-	Pointer to Unit's HEX block

e. <u>LINKAGES TO OTHER DATA STRUCTURES</u>

The CRC STRUCTURE is linked to both the HEX ADDRESS TREE and the C^2 TREES of both sides.

f. <u>NOTES</u>

4. BLUE AIRBASES (B-AB)

a. Data Block Index

ABINFO

ABQUEDB

ABSTATUS

ACDB

C^2

QUEUES

QUESTAT

SB

b. Description

BLUE AIRBASE STRUCUTRES are designed to keep track of the number and type of aircraft on the AIRBASE as well as the status of each aircraft type in terms launch capability. The overall configuration of these structure is shown in the structure diagram.

c. Structure Overview

1) Structure Diagram (Figure III-24)

2) Block Definitions

C^2	-	COMMAND CONTROL BLOCK. Contains unit no., type and side, and C^2 PTRS.
SB	-	SCOREBOARD BLOCK. Contains HEX address PTR, Unit ID, PTR to future event list for the unit, and ABSTATUS PTR.
SDB	-	STATUS DISPLAY BLOCK. Not used by airbase.
ABSTATUS	-	AIRBASE STATUS BLOCK. Contains PTRS to the airbase information list (ABINFO) and the QUEUES list for each aircraft type on base.
ABINFO	-	AIRCRAFT ON BASE INFORMATION BLOCK. Contains aircraft type, no on hand and no. in each service queue, and a PTR to A/C type's ACDB.

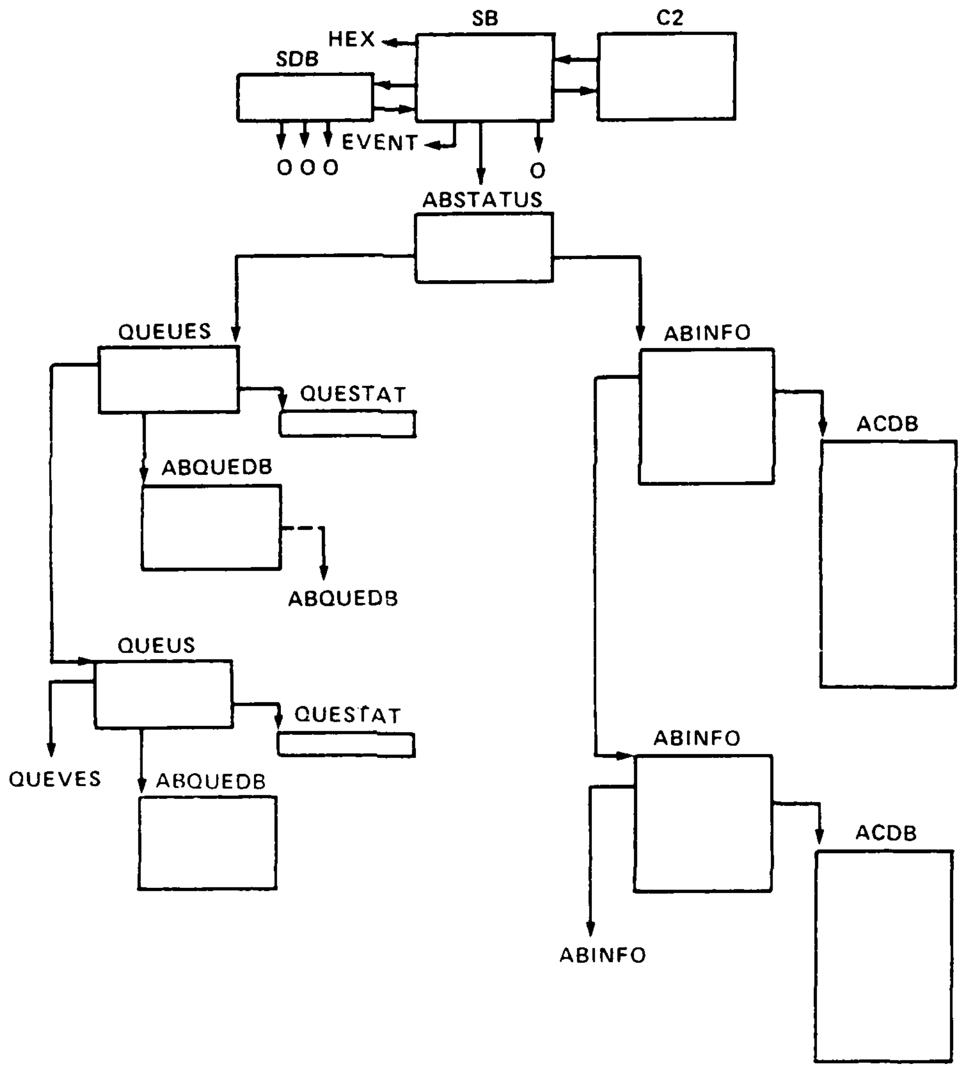


Figure III-24. Blue Airbase Structure Diagram

4368/79W

QUEUES - AIRCRAFT SERVICE QUEUE BLOCK
ABQUEDB - AIRBASE QUEUE DATA BASE BLOCK
QUESTAT - QUEUE STATUS BLOCK.
ACDB - AIRCRAFT DATA BASE BLOCK. Operational parameters of A/C type.

d. Block Specification

1) Block Diagrams

a) C^2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PABSTATUS

c) ABSTATUS

PACTAB	NOACTAB
PTR2QUES	NOACONAB
ABDAMAGE(SPACE)	

d) QUEUES

NEXT	QUENUM
PTR	NUMBER
PQDB	PQUESTAT

e) QUESTAT

VALUE(SPACE)

f) ABQUEDB

PNEXT	CLASS
VALUE1 (SPACE)	
VALUE2 (SPACE)	
VALUE3 (APCE)	

g) ABINFO

NEXT	NRACTYP
NOACOH	PTRACDB
NORMRQ	
NORMEARMQ	
NOREFVELQ	
NOLAUNCHQ	

h) ACDB

NEXT	NRACTYPE
MAXSPEED (SPCE)	
CRUISESPEED (SPACE)	
MAXALTITUDE (SPACE)	
MINALTITUDE (SPACE)	
FUELCONSUME (SPACE)	
ACQRANGE (SPACE)	
RADARCS (SPACE)	
ATTACKRADIUS (SPACE)	
MAXFUEL (SPACE)	

2) Field Specifications

a) C^2 BLOCK

UNITNUMBER - Unit number

PUP - Pointer to C^2 block of unit's commander

PDOWN - Pointer to C^2 block of unit's subordinate

PSB - Pointer Unit's SB block

PNEXT - Pointer to Unit's sibling. C^2 block

UNITTYPE - Unit type code (220)

SIDE - Unit affiliation
1 = Blue (NATO)
2 = Red (PACT)

b) <u>SB BLOCK</u>

ADDRESS	-	Pointer to HEX block in which unit is located.
PC2	-	Pointer to C^2 block of the unit.
PSDB	-	Pointer to SDB block (Inactive)
PFEL	-	Pointer to future event list for the unit.
PACQ	-	Pointer to acquisition devices (inactive)
ID	-	Unit ID number
DATABASE	-	Pointer to database block (inactive)

c) <u>ABSTATUS BLOCK</u>

PACTAB	-	Pointer to ABINFO block.
NOACTAB	-	Number of ABINFO blocks in the list corresponds to number of aircraft on the base
PTR2QUES	-	Pointer to QUEUES BLOCK
NOACONAB	-	Number of QUEUES blocks in the list. Corresponds to number of aircraft types on the base.
ABDAMAGE	-	Damage level of base. Real variable.

d) <u>QUEUES BLOCK</u>

NEXT	-	Pointer to next QUEUES block in the list.
QUENUM	-	QUEUE number (2 = ready queue)
PTR	-	
NUMBER	-	
PQDB	-	Pointer to ABQUEDB block
QPESTAT	-	Pointer to QUESTAT block

e) <u>QUESTAT BLOCK</u>

VALUE	-	Unknown, real variable

f) <u>ABQUEDB BLOCK</u>

PNEXT	-	Pointer to next ABQUEDB block
CLASS	-	Aircraft class
VALUE1	-	
VALUE2	-	
VALUE3	-	

g) <u>ABINFO BLOCK</u>

NEXT	-	Pointer to next ABINFO block
NRACTYP	-	Aircraft type code
NOACOH	-	Number of aircraft of type (NRACTYP) on hand on the base.
PTRACDB	-	Pointer to ACDB for the aircraft type (NRACTYP)
NORMRQ	-	Number in repair queue
NOREARMQ	-	Number in rearm queue
NOLAUNCHQ	-	Number in launch queue

h) <u>ACDB BLOCK</u>

NEXT	-	Pointer to next ACDB block in data base (not used in this context)
NRACTYPE	-	Aircraft type code
MAXSPEED	-	Maximum speed. Real variable
CRUISESPEED	-	Cruising speed. Real variable
MAXALTITUDE	-	Maximum altitude. Real variable
MAXCLIMBDIVE	-	Maximum rate of altitude change. Real variable.
FUELCONSUME	-	Fuel consumption rate. Real variable.
ACQRANGE	-	Acquisition range. Real variable.

RADARCS	-	Radar cross-section. Real variable.
ATTACKRADIUS	-	Maximum attack range of aircraft. Real variable.
MAXFUEL	-	Maximum fuel capacity. Real variable.

e. <u>Linkages to Other Data Structures</u>

f. <u>Notes</u>

QUEUES blocks and their related lists are not used at present.

5. Blue Flights (B-FLT)

a. Data Block Index

ACDB

AQDB

ARCFSAW

ARCFTSTATUS

C^2

COMMAND

FLTDB

FORMATION

LOAD

MUN

ORDERES

PAYDDBLOK

PAYLOAD

SB

SEEBUF

WINGMAN

b. Description

The BLUE FLIGHT DATA STRUCTURES control the actions of blue flights. In addition to the three command/control blocks C^2; SB and SDB, BLUE FLIGHTS also use three lists. These lists include: the PERCEPTIONS LIST, the ORDERS LIST and the FLIGHT STATUS LIST.

The PERCEPTIONS LIST is composed of a buffer and a singly-linked list of ARCFSAW blocks. These ARCFSAW blocks contain information on Red flights perceived by the Blue FLIGHT. This inforamtion includes the location of the Red targets. When the Blue FLIGHT returns to its' airbase the perceived damage to Red Flights is transfered to the Blue CRC.

The ORDERS LIST is composed of two buffered lists. The first is made-up of up to six COMMAND blocks which specify the actions to be taken by the flight at various points in its' mission. These COMMAND blocks determine the flight geometry and mission profile for the flight. The second list is made up to WINGMAN blocks which contain pointers. To the SB blocks of other flights in the other Blue FLIGHTS in the formation.

The FLIGHT STATUS LIST consists of an ARCFTSTATUS block which tracks flight status and a set of two NUMITIONS LISTS which keep track of air-to-air and air-to-ground ordinance carried by the Red Flight. The ARCFSTATUS block points to an FLTOB block which is the core of a FLIGHT DATA BASE STRUCTURE. This structure is used as a template for construction of flights of specified types. It provides the basic aircraft characteristics and initial payload levels used to create and operate the flight.

Both the FLIGHT DATA STRUCTURES and the FLIGHT DATA BASE STRUCTURES are shown in the structure diagrams.

c. Structure Overview

1) Structure Diagrams (Figures III-25 & III-26)

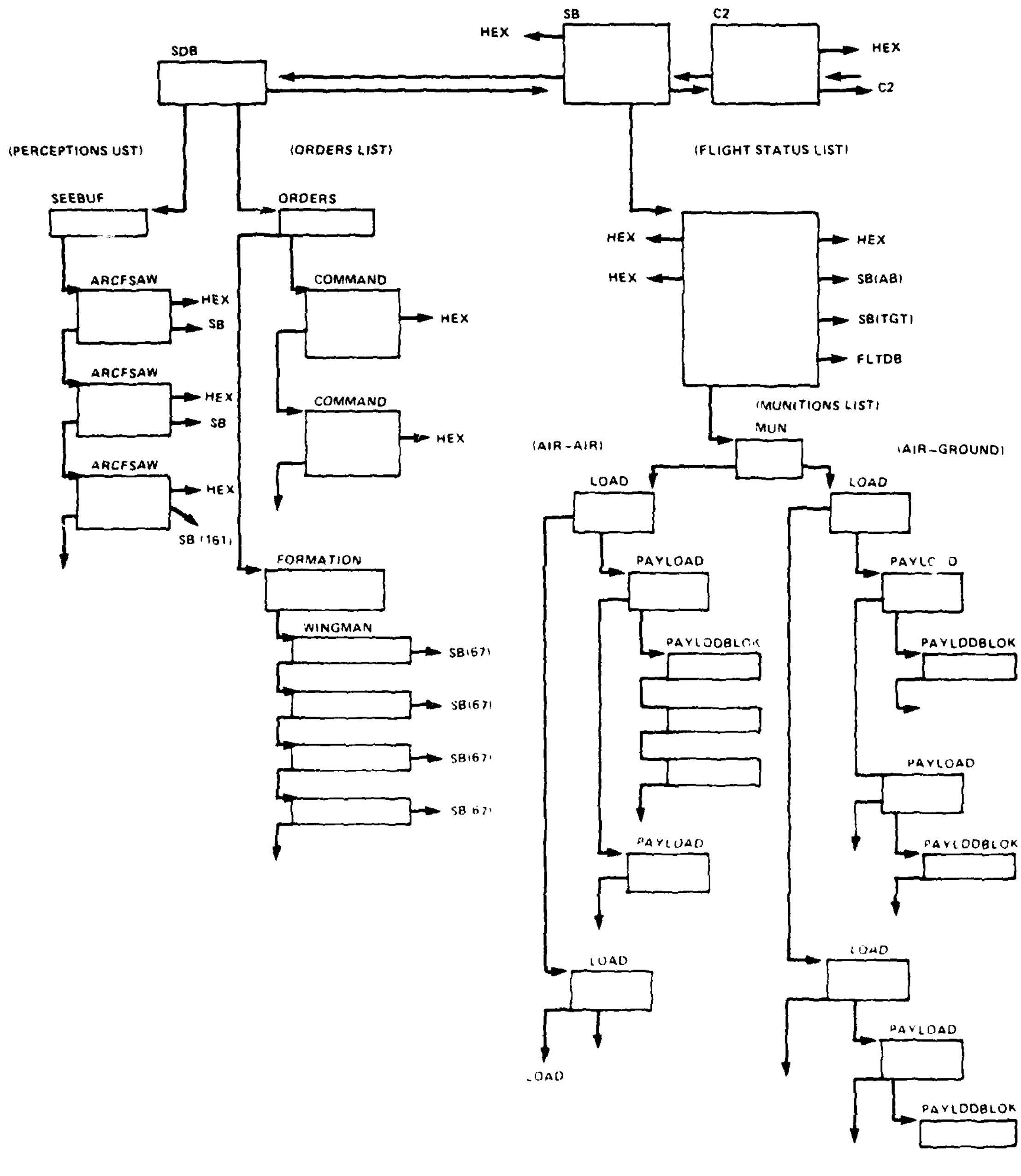


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Figure III-25. Blue Flight Structure Diagram

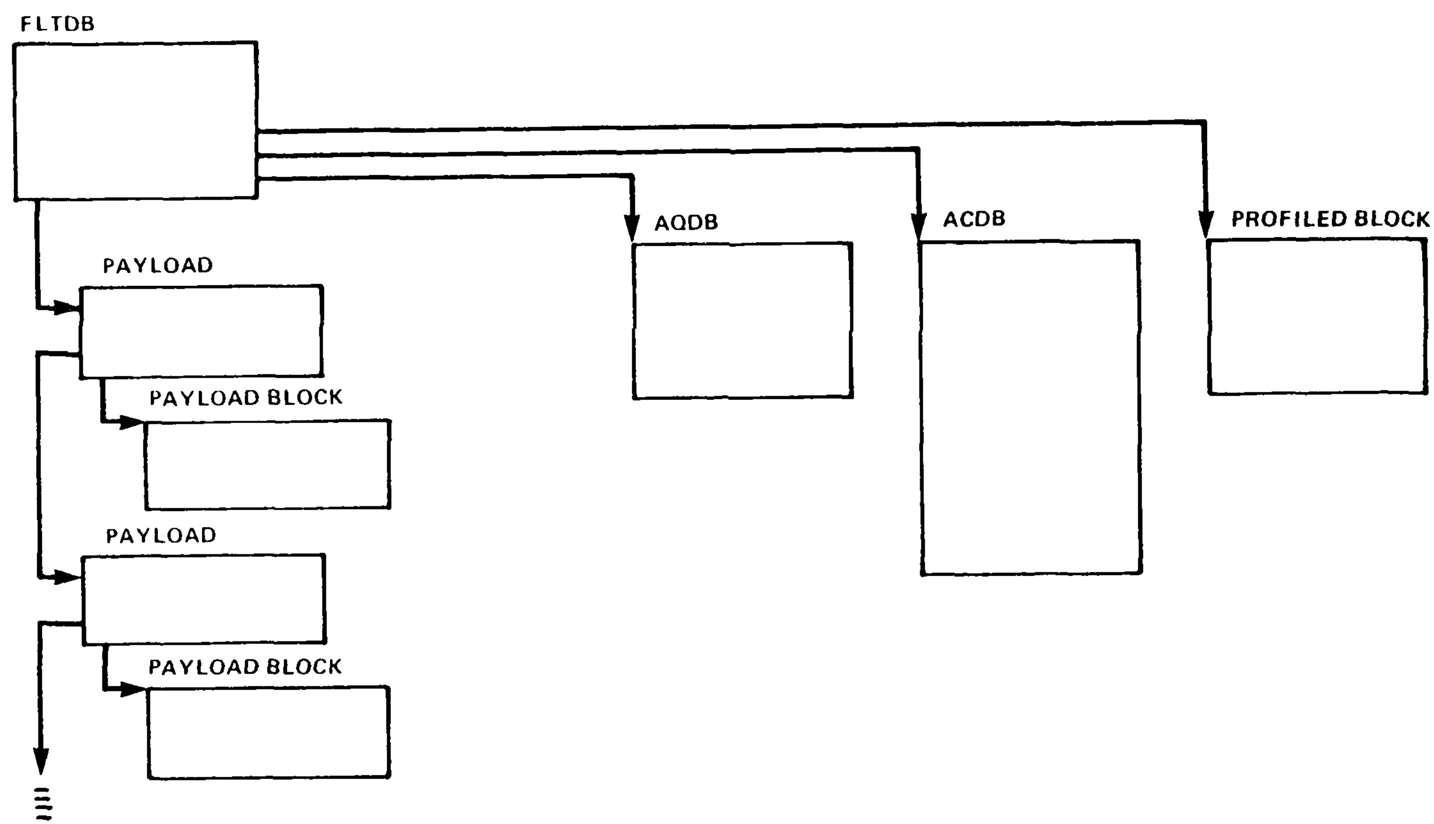

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Figure III-26. Flight Data Base Structure Diagram

2) Block Definitions

COMMAND/CONTROL BLOCKS

C^2	-	COMMAND/CONTROL BLOCK. Contains Unit No., type, side, and C^2 PTRS.
SB	-	SCOREBOARD BLOCK. Contains HEX address, unit ID, PTR to FEL and STAT
SDB	-	STATUS DISPLAY BLOCK. Contains PTRS to perceptions list (SEEBUF) and orders list (ORDERS). Subordinate PTR not used by Red FLTS.

FLIGHT STATUS LIST

ARCFTSTATUS	-	FLIGHT STATUS BLOCK. Contains basic flight status information includes PTRS to startin, ending and next HEX address in current move. Also includes PTRS to homebase and TGT SB's a status word, and current fuel, altitude, speed, and direction.
MUN	-	MUNITIONS LIST BUFFER BLOCK. Buffer for air to air and air to ground munitions lists.
PAYLOAD	-	PAYLOAD CLASS DESCRIPTION BLOCKS. Basic payload parameters for class of ordinance. Contains class type, max and min amounts and max fire range. Also includes PTR to a list of attached ordinance types of the same class.

PAYDDBLOK	-	PAYLOAD TYPE DATA BASE BLOCK. Contains PTR to next PAYDDBLOK and type of ordinance.
LOAD	-	PAYLOAD LIST BUFFER. Used to break payloads into types and keep track of ammunition load weight.
PERCEPTIONS LIST		
SEEBUF	-	PERCEPTIONS LIST BUFFER BLOCK
ARCFSAW	-	AIRCRAFT PERCEPTION BLOCK. Contains infomration on entity perceived by a flight. Includes PTR to HEX and SB of entity.
ORDERS LIST		
ORDERS	-	ORDERS LIST BUFFER BLOCK. Contains no. of orders remaining.
COMMAND	-	COMMAND DESCRIPTION BLOCK. Describes command to be followed by flight at specified address. Up to six in the list.
FORMATION	-	FORMATION BUFFER BLOCK. Contains number of flts in the formation to which the flight belongs.
WINGMAN	-	WINGMAN LIST BLOCK. Contains PTR to other flts in the formation.

FLIGHT DATA BASE

FLTDB	-	FLIGHT DATA BASE BLOCK. Contains basic flight description including no. of payloads, maximum no. of A/C, minimum No. of A/C, and Multic SPFLTC(SPACE, DISTSER(SPACE)
PAYLOAD	-	PAYLOAD DESCRIPTION BLOCK. Contains payload class (NRPDCLS) max and min amount of payload, and max fire range
PAYLDDBLOK	-	PAYLOAD TYPE BLOCK. Contains payload type index
AQDB	-	ACQUISITION DEVICE DATA BASE BLOCK. Contains type index and range of acquisition device.
ACDB	-	AIRCRAFT DATA BASE BLOCK. Contains A/C characteristics such as speed, max range etc.
PROFILEDBLOK	-	MISSION PROFILE BLOCK. Contains flight altitude levels for three phases of mission - ALT to corridor entrance, ALT to TGT, and ALT from TGT to Airbase.

1) Block Diagrams

a) C^2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PABSTATUS
+	PARCFTSTAT
+	PBOCSTAT
+	PBTRYSTAT
+	STATUS

c) SDB

PSB	PSEEBUF
+	PSEE
SUBORDINATE	ORD
+	PRAID

d) SEEBUF

PTRSEE	NUNITS

e) ARCFSAW

PNEXT	PSB
ADDRESS	TYPE
DAMAGE (SPACE)	

f) ORDERS

PTRFORMS	PTRACT

g) COMMAND

PNEXT	NUMACTS
TMFLG	ADDRESS
TIME (SPACE)	
ACTION	

h) FORMATION

PFORM	NUMFLTS

i) WINGMAN

PNEXT	PSB

AD-A107 916 BDM CORP MCLEAN VA F/G 15/3
MODULAR AIR DEFENSE EFFECTIVENESS MODEL, PROGRAM DOCUMENTATION --ETC(U)
JAN 80 M FILTEAU, B MACALEER, J T HAWKINS DNA001-79-C-0230
UNCLASSIFIED BDM/W-79-646-TR-VOL-2 DNA-5594F-2 NL

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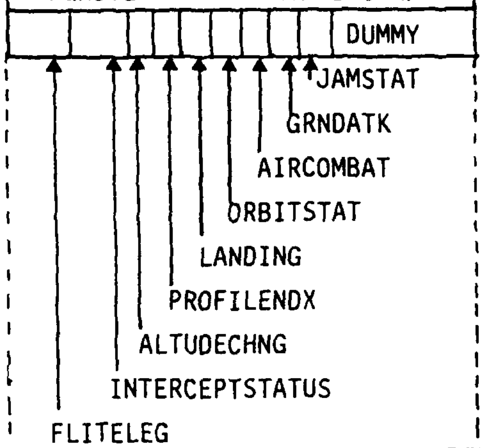
j) ARCFTSTATUS

PFLTDB	PMUNITIONS
PSTRTHX	PENDHX
PNXTHX	PAIRBASE
CNTRLMODE	PAIRTGT
PGNOTGT	NUMAIRCRAFT



FUEL (SPACE)
ALTITUDE (SPACE)
SPEED (SPACE)
DIRECTION (SPACE)

k) MUN

PAG	NUMAG
PAA	NUMAA

1) LOAD

PNEXT	TYPE
AMOUNT	PORDDB

1) FLTDB

PNXFLDB	NRFLITE
PTYPLDS	NOPYLDS
PTYAQDB	PTACDB
MAXNOAC	MINNOAC
MULTAC	PROFILE
SPFLTC (SPACE)	
DISTSEP (SPACE)	

n) PAYLOAD

PNXTYPD	NRPDCLS
MAXAMT	MINAMT
MAXFIRERANGE	PAYLODB

o) PAYLDDBLOK

NEXT	TYPEINDEX

p) AQDB

NEXT	NRAQTYP
RANGE (SPACE)	
NOUSE1	
NOUSE2	

q) PROFILEDBLOK

PNXPRDB	NRPROFL
ALTCREN (SPACE)	
ALTOTGT (SPACE)	
ALTOAB (SPACE)	

r) ACDB

NEXT	NRACTYPE
MAXSPEED (SPACE)	
CRUISESPEED (SPACE)	
MAXALTITUDE (SPACE)	
MINALTITUDE (SPACE)	
MAXCLIMBDIVE (SPACE)	
FUELCONSUME (SPACE)	
ACQRANGE (SPACE)	
RADARCS (SPACE)	
ATTACKRADIUS (SPACE)	
MAXFUEL (SPACE)	

2) Field Definitions

a) C^2 BLOCK

UNITNUMBER - Number of the unit.

PUP - Pointer to the C^2 block of the unit's commander.

PDOWN	-	Pointer to the C^2 block of the unit's sibling.
PSB	-	Pointer to the SB block of the unit.
UNITTYPE	-	The unit's type code (128)
SIDE	-	Unit affiliation 2 = Red (PACT)

b) <u>SB BLOCK</u>

ADDRESS	-	Pointer to HEX block of the HEX in which the unit is located
PL2	-	Pointer to C^2 block of the unit.
PSDB	-	Pointer to the SDB block of the unit.
PFEL	-	Pointer to future event list EVENT block.
PACQ	-	Pointer to ACQBUF block. Used by CRC's for acquisition devices.
ID	-	Identification number.
DATABASE	-	If BOC or BTRY points to ADSITEDB block
PABSTATUS	-	Points to ABSTATUS block if the unit is an airbase
+PARCFTSTAT	-	Points to ARCFTSTATUS block if the unit is a flight of aircraft
+PBOCSTAT	-	Points to BOCSTAT block if the unit is a battalion operations center.
+PBTRYSTAT	-	Points to BTRSTAT block if the unit is an anti-aircraft battery
+STATUS	-	Alternative field definition.

c) SDB BLOCK

PSB	-	Pointer to the unit's SB block
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their perceived damage levels. This field definition is used only by flights.
+PSEE	-	Pointer to CRCEES block which is used by CRC units to record the blue and red flights it sees. Also by the RTC as a pointer to it's assigned target list.
SUBORDINATE		Points to different types of subordinate description or target description blocks depending upon the unit type. Possible unit type vs. field use combination are as follows:

UNIT TYPE	SUBORDINATE POINTS TO
CRC	SUB
BOC	SUBLIST
BTRY	FIREUNIT

ORD	-	Points to ORDERS block if the unit is a flight.
+PRAID	-	Points to the RAIDBLOK if the unit is the Red Theater Commander.

d) SEEBUF BLOCK

PTRSEE	-	Pointer to ARCFSAW block (first in list)

NUNITS	-	Number of ARCFSAW blocks in the list. Corresponds to number of targets perceived.

e) ARCFSAW BLOCK

PNEXT	-	Pointer to next ARCFSAW block in the list.
PSB	-	Pointer to SB block of target.
ADDRESS	-	Pointer to HEX block in which target is located.
TYPE	-	Unit type code of target
DAMAGE	-	Perceived damage level of the target. Real variable.

f) ORDERS BLOCK

PTRFORMS	-	Pointer to FORMATION block
PTRACT	-	Pointer to COMMAND block.
PNEXT	-	Pointer to next command block.
NUMACTS	-	Number of the command in the list.
TMFLG	-	Time flag. If 1 at time is associated with the command.
ADDRESS	-	Pointer to HEX block in which the command is to be carried out.
TIME	-	Time the command is to be performed.
ACTION	-	Command or action code

h) FORMATION BLOCK

PFORM	-	Pointer to first WINGMAN block in the list.
NUMFLTS	-	Number of WINGMAN blocks in the list. Corresponds to number of flights in the formation.

i) <u>WINGMAN BLOCK</u>

PNEXT	-	Pointer to next WINGMAN block in the list
PSB	-	Pointer to the SB block of the flight.

j) <u>ARCFTSTATUS BLOCK</u>

PFLTDB	-	Pointer to FLTDB block
PMUNITIONS	-	Pointer to MUN block
PSTRTHX	-	Pointer to HEX block in which current move begins
PENDHX	-	Pointer to HEX block in which current move ends
PNXTHX	-	Pointer to next HEX block
PAIRBASE	-	Pointer to SB block of flight's home airbase.
CNTRLMODE	-	
PAIRTGT	-	Pointer to SB block of airborn target.
PGNDTGT	-	Pointer to SB block of ground target
NUMAIRCRAFT		Number of aircraft in the flight
FLITELEG		
INTERCEPTSTATUS		
ALTUDECHNG		
PROFILENDX		
LANDING		
ORBITSTAT		
AIRCOMBAT		
BRNDATK		
FUEL	-	Current fuel level. Real variable

ALTITUDE	-	Altitude in meters. Real variable
SPEED	-	Speed. Real variable
DIRECTION	-	Direction. Real variable.

k) <u>MUN BLOCK</u>

PAG	-	Pointer to ground attack LOAD block
NUMAG	-	Number of LOAD blocks in ground attack munitions list.
PAA	-	Pointer to air attack LOAD block
NUMDA	-	Number of LOAD blocks in air attack munitions list.

l) <u>LOAD BLOCK</u>

PNEXT	-	Pointer to next LOAD block in the list
TYPE	-	Munitions class
AMOUNT	-	Amount of munitions in tons
PORDDB	-	Pointer to PAYLOAD block

m) <u>FLTDB BLOCK</u>

PNXFLDB	-	Pointer to next FLTDB block
NRFLITE	-	Unique flight specification number
PTYPLDS	-	Pointer to payload data block payload class 6002
NOPYLDS	-	Number of payload data blocks
PTYAQDB	-	Pointer to acquisition data block (AQDB, Class 6007)
PTACDB	-	Pointer to aircraft specification data block (ACDB, Class 6003)
MAXNOAC	-	Maximum number of aircraft in flight

MINNOAC	-	Minimum number of aircraft in flight
MULTAC	-	Multiples of aircraft required for flight
PROFILE	-	Pointer to profile specification data block (PROFILEDBLOK), Class 6005)
SPFLTC(SPACE)		Flight cruising speed in meters/ second (real)
DISTSEP(SPACE)		Flight separation distance in meters (real)

n) <u>PAYLOAD BLOCK</u>

PNXTYPD	-	Pointer to next PAYLOAD block
NRPDCLS	-	Payload type, must be 3 or 4 3 = air to ground 4 = air to air
MAXAMT	-	Maximum number of loads of this payload
MINAMT	-	Minimum number of loads of this payload
MAXFIRERANGE		Future use by an enhancement for maximum fire range for engagements greater than one hex
PAYLDDB	-	Pointer to PAYLOAD ID data block (PAYLDDBLOK)

o) <u>PAYLDDBLOK BLOCK</u>

NEXT	-	Pointer to next ID block
TYPEINDEX	-	Payload ID, unique within each payload type

p) <u>AQDB BLOCK</u>

NEXT	-	Pointer to next AQDB block
NRAQTYP	-	Unit type

6. BATTALION OPERATIONS CENTERS (BOC)

a. Data Block Index

ABSITEDB

BOCSTAT

C2

DIB

DIL

PAL

PERLIST

SB

SDB

SOURCE

SUBLIST

b. Description

The air defense information for the Battalion Operations Center (BOC) in MADEM is stored in the Digested Information List (DIL). The DIL is integrated with the subordinates of the BOC to create the Threat-Defense Analysis Structure for each BOC.

The DIL represents the perceived threat to the BOC and is pointed to from the BOC's Status Board (BOCSTAT). The list of subordinates to the BOC are pointed to from the BOC Status Display Board (SDB). The BOC links its available subordinates to the targets producing the Threat-Defense Analysis Structure, made up of Possibilities and Allocations Lists (PAL) blocks. This structure of PAL blocks is in the form of a sparse matrix. Conceptually, the rows of the matrix shows what targets (DIL's) are associated with each subordinate (SUBLIST) so the subordinate can be maximally allocated. The columns are each target, DIL, and the subordinates that are currently associated with it. The elaborate linking allows easy addition or deletion from the matrix as well as ease of searching for the information needed.

The DIL's are divided up into three different configurations: (1) Active DIL list, (2) Passive DIL list, (3) Force out queue. This allows

the threats, DIL's, to be handled in a systematic way. All the DIL configurations are pointed to from the BOCSTATUS.

The Active DIL (ADIL) is a doubly linked circular list of all the threats actively being considered by the BOC. The DIL's in the ADIL are also doubly threaded creating a list in sequence of priorities. Each DIL in the ADIL is considered one at a time in the list in increments controlled by the Scheduled Digest event. The Air Defense Data Base controls the maximum number of DIL's a BOC can have in its ADIL.

When a BOC fully assigns the responsibility of a threat, DIL, its subordinates, the DIL is taken out of the ADIL and put into the Passive DIL list (PDIL). The PDIL is a doubly linked list of DIL blocks with a pointer to the head of the list.

If a DIL in the ADIL is forced out because the need to bring in a DIL of a higher priority, it is put in the Force Out Queue (FOQ). The FOQ is a double linked list with a head and tail pointer to the list. This is an overflow list and the DIL will eventually be brought back into the ADIL when there is an opening. The head and tail pointers allow access from either end of the list to get the best DIL out of the FOQ.

Each DIL has an associated Digested Information Block (DIB) with it. This holds the current information that the BOC has on the target. When the DIL is in the Active DIL List a new DIB is created and compared to the old one each time the DIL (target) is examined. The DIL's are also associated with the Perceptions List, a PERLIST block from the Perceptions List and a DIL are linked up. The information in the PERLIST is from the Perception event and is used with the DIL to represent the information on a target.

c. Structure Overview

1) Structure Diagrams (Figure III-27, III-28, III-29)

2) Block Definitions

$\underline{C^2}$ - COMMAND/CONTROL BLOCK. Contains unit no., type, side and C^2 PTRS.

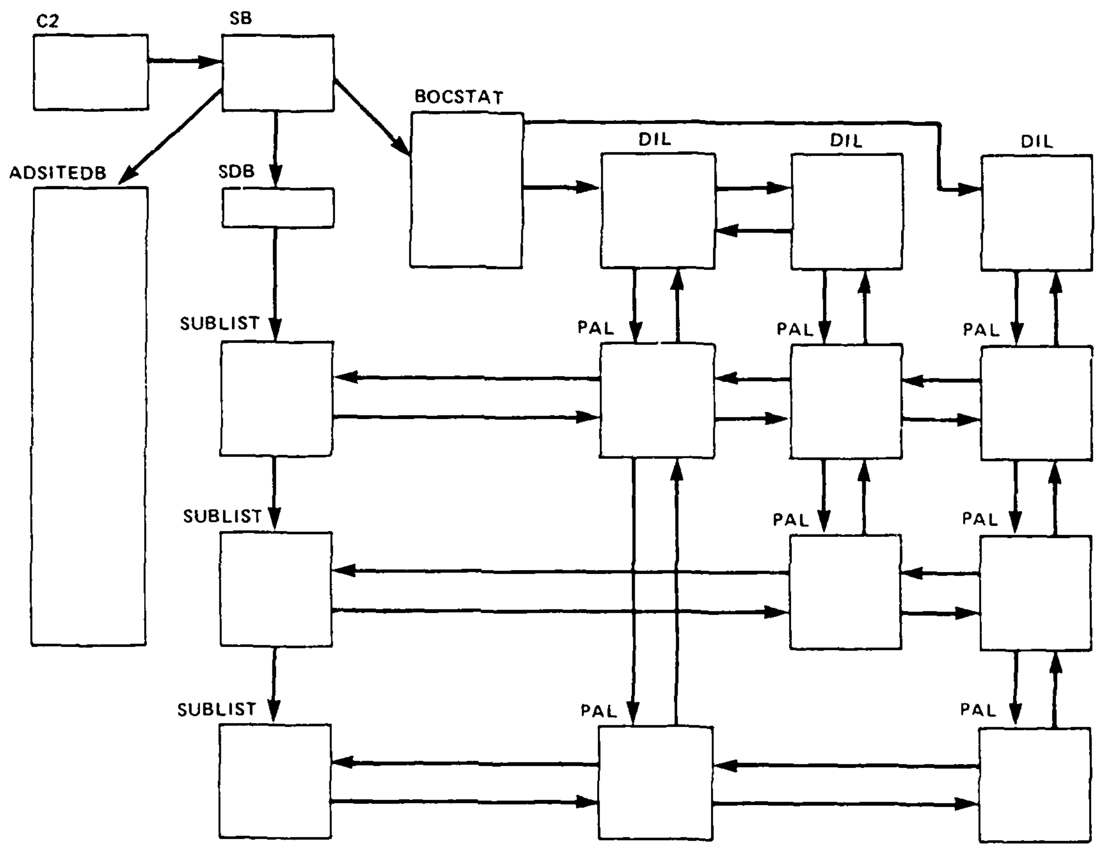


Figure III-27. Battalion Operations Center Structure Diagram

4368/79W

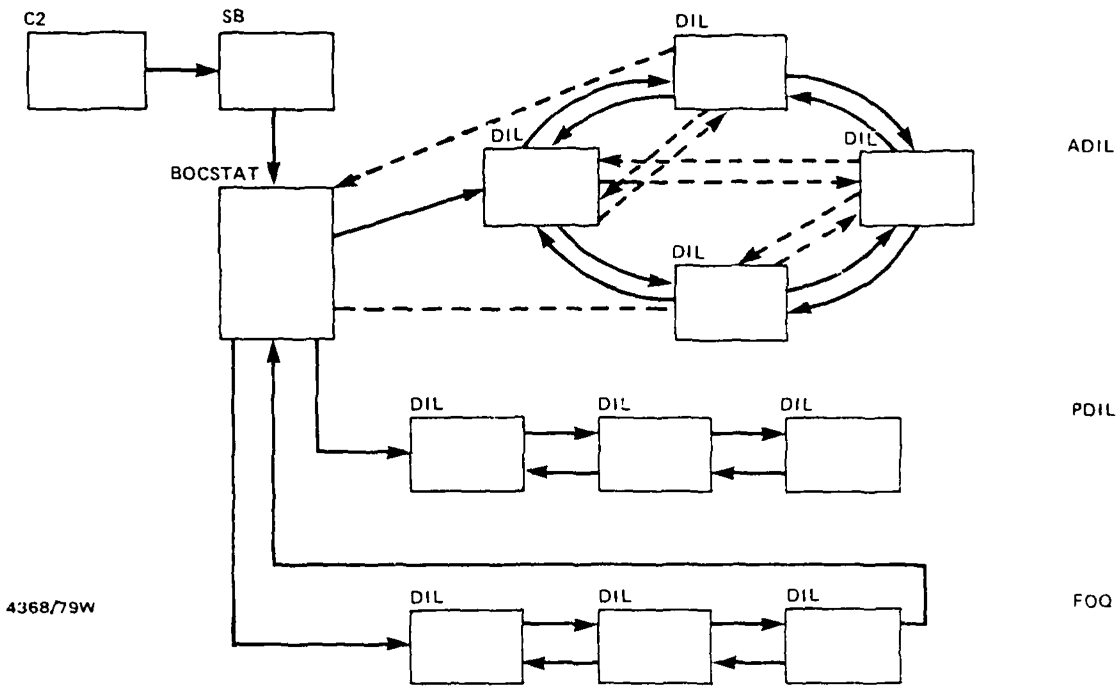


Figure III-28. Digested Information List Configurations

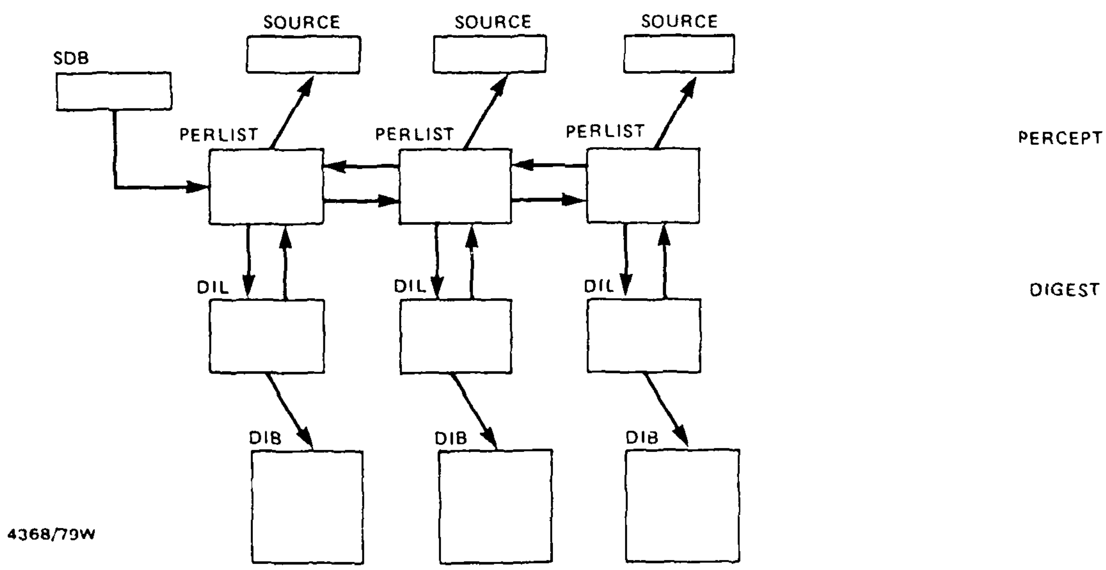


Figure III-29. Digested Information List and Perception List

SB	-	SCOREBOARD BLOCK. Contains HEX address; unit ID, PTR to BOCSTAT
SDB	-	STATUS DISPLAY BLOCK. Contains PTRS to subordinate list and perceptions list.
ADSITEDB	-	AIR DEFENSE SIGHTED DATA BLOCK. Contains information on the sighted aircraft
BOCSTAT	-	BOC STATUS BOARD. Contains PTR to the three DIL configurations, ADIL, TRACKED, FOQ, along with general info on the BDC
DIL	-	DIGESTED INFORMATION LIST. Contains information on a target or possible target on coverage, engagement windows, and other info, contains PTRS to associated DIL and perception block
SUBLIST	-	SUBORDINATE LIST BLOCK. Subordinate to the BOC, can be associated with one or more targets
PAL	-	POSSIBILITIES AND ALLOCATIONS LIST. Created when a subordinate and a target are associated together
PERLIST	-	PERCEPTIONS LIST BLOCK. Forms a list, contains information on the seeing status of the target

DIB - DIGESTED INFORMATION BLOCK. Contains information on the target as heading, velocity, and position

d. <u>Block Specifications</u>

1) <u>Block Diagrams</u>

a) C2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITYPE	SLIDE

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	ID
DATABASE	PBOCSTAT

c) SDB

PSB	PSEEBUF
SUBORDINATE	ORD

d) SUBLIST

BTRYSB	PNEXT
AUTO	NUMFU
RAMMO	LOAD
PDAQUE	NOUSE
PPAL	ADDRESS

e) BOCSTAT

AUTOFLG	READY
PSDIG	PSDELY
PADIL	NUMADIL
PHFOQ	PTFOQ
PHNDIL	PTNDIL
HPRIOR	TPRIOR
PPDIL	NUMROY
PHADAQ	PTDAQ

f) DIL

PUP	PDOWN
PPERCL	PDIB
LDC	PRIORITY
PRIUP	PRIDN
DCOV	SHORT
PDELAY	PENGEV
PPAL	PSUB

g) PAL

PUPT	PDOWNT
PUPB	PDOWNB
START (SPACE)	
END (SPACE)	
COVER	POIL
PEVENT	PSUB

h) ADSITEDB

PNEXT	ADTYPE
MODVAL1	MAXNUMDIGEST
MAXTIMEDIGEST	MINTIMEDIGEST
LOSTTIME (SPACE)	
LASTCHANGE (SPACE	
ENGAGEWINDOW(SPACE	
MODVAL2 (SPACE)	
MODVAL3 (SPACE)	
LOVONONE	ONE
COVONFEW	FEW
COVONMANY	MANY
TIMEFLIGHT (SPACE	
MISSILERANGE (SPACE)	
MAXASSIGN	MODVAL4
MODVAL5 (SPACE)	
MAXTRACKRANGE (SPACE)	
LOCKONTIME (SPACE)	

h) ADSITEDB (Continued)

MODVAL6 (SPACE)	
MODVAL7 (SPACE)	
CONVLOAD	
SNUKELOAD	LNUKELOAD
RESUPPLYCV	CVRESUPPLYFREQ
RESUPPLYSN	SNRESUPPLYFREQ
RESUPPLYLN	LNRESUPPLYFREQ

i) DIB

TIME (SPACE)	
SIDE	NUMAL
LOST	POSITION
HEADING (SPACE)	
VELOCITY (SPACE	
ALTITUDE (SPACE)	

j) PERLIST

PUP	PDOWN
PSB	PDIL
SEEN	PSS
PUPCHN	PDNCHN
TIME (SPACE	

k) SOURCE

PSB	PNEXT

2) Field Definitions

a) C^2 Block

UNITNUMBER - Number of the unit. If negative, the unit is a passing target.

PUP - Pointer to the C2 block of the unit's commander.

PDOWN - Pointer to the C2 block of the unit's subordinate.

PNEXT	-	Pointer to the C2 block of the unit's sibling.
PSB	-	Pointer to the SB block of the unit.
UNITTYPE	-	The unit's type code (see sub-section f).
SIDE	-	Unit affiliation. 1 = Blue (NATO) 2 = Red (Pact)

b) SB Block

ADDRESS	-	Pointer to HEX block of the hex in which the unit is located.
PC2	-	Pointer to C2 block of the unit.
PSDB	-	Pointer to the SDB block of the unit.
PFEL	-	Pointer to future event list EVENT block.
PACQ	-	Pointer to ACQBUF block. Used by CRC's for acquisition devices.
ID	-	Identification number.
DATABASE	-	If BOC or BTRY points to ADSITEDB block.
PBOCSTAT	-	Points to BOCSTAT block if the unit is a Battalion Operations Center.

c) SDB Block

PSB	-	Pointer to the unit's SB block.
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their percieved damage levels. This field definition is used only by flights.

SUBORDINATE	-	Points to SUBLIST block which is a list of subordinates.
ORD	-	Points to ORDERS block if this unit is a flight.

d) SUBLIST

BTRYSB	-	Pointer to the SB block of the BOC.
PNEXT	-	Pointer to the SUBLIST block of the subordinate's sibling.
AUTO	-	
NUMFU	-	
RAMMO	-	
LOAD	-	
PDAQUE	-	Pointer to the DAQUE block.
NOUSE	-	
PPAL	-	Pointer to the possibilities and allocations list block.
ADDRESS	-	Pointer to the HEX block.

e) BOCSTAT

AUTOFLG	-	
READY	-	
PSDIG	-	Pointer to the EVENT block which is the next scheduled digest event.
PSDELY	-	Pointer to the EVENT block.
PADIL	-	Pointer to the DIL block which is the next threat (DIL) to look at in the active DIL list.
NUMADIL	-	Number of DILS in the active DIL list.
PHFOQ	-	Pointer to the DIL block which is the head of the Force Out Queue.

PTFOQ	-	Pointer to the DIL block which is the tail of the Force Out Queue.
PHNDIL	-	Pointer to the PERLIST block. This pointer is not actively used in MADEM at present.
PTNDIL	-	Pointer to the PERLIST block. This pointer is not actively used in MADEM at present.
HPRIOR	-	Pointer to the DIL block which is the head of the priority chain within the active DIL list.
TPRIOR	-	Pointer to the DIL block which is the tail of the priority chain within the active DIL list.
PPDIL	-	Pointer to the DIL block which is the head of the passive DIL list.
NUMROY	-	
PHDAQ	-	
PTDAQ	-	

f) DIL

PUP	-	Pointer to the DIL block which is the pointer up in DIL chain.
PDOWN	-	Pointer to the DIL block which is the pointer next in DIL chain.
PPERCL	-	Pointer to the PERLIST block which is the pointer to the perceptions list.

PDIB	-	Pointer to the DIB block which is the digested information block. It holds the information about the flight's track.
LOC	-	The code to tell which DIL configuration this DIL is located. Code: 0 - Active Dil List 1 - Force Out Queue 2 - Passive Dil List
PRIORITY	-	Priority of
PRIUP	-	Pointer to the DIL block which is the up pointer in the priority chain in the active DIL list.
PDOWN	-	Pointer to the DIL block which is the down pointer in the priority chain in the active DIL list.
DCOV	-	Desired coverage of this target flight.
SHORT	-	Shortfall from desired coverage, i.e., Desired-Allocated = Shortfall.
PDELAY	-	Pointer to the DAQE block which points to the delayed action queue, a chain of delayed actions regarding this target.
PENGEV	-	Pointer to the EVENT block.
PPAL	-	Pointer to the PAL block which is the possibilities and allocations list block, a part of the threat-defense analysis.
PSUB	-	Pointer to the SUBLIST block.

g) <u>PAL</u>

- <u>PUPT</u> - Pointer to the <u>PAL</u> block.
- <u>PDOWNT</u> - Pointer to the <u>PAL</u> block.
- <u>PUPB</u> - Pointer to the <u>PAL</u> block.
- <u>PDOWNB</u> - Pointer to the <u>PAL</u> block.
- <u>START</u> - Beginning time that the target is active for this BOC.
- <u>END</u> - Ending time that the target is active for this BOC.
- <u>COVER</u> - Amount of coverage the subordinate is giving this target.
- <u>PDIL</u> - Pointer to the <u>PAL</u> block which is the target (DIL) associated with this PAL.
- PEVENT - Pointer to the <u>EVENT</u> block.
- <u>PSUB</u> - Pointer to the <u>SUBLIST</u> block which is the subordinate associated with this PAL.

h) <u>ADSITEDB Block</u>

- PNEXT - Pointer to next ADSITEDB block.
- ADTYPE - Unit type of this unit. Must be a BOC or BTRY.
- MODVAL 1 - Model Value - 1.
- MAXNUM DIGEST - Maximum number of flights on which a BOC or BTRY can be digesting info at one time.
- MAX TIME DIGEST- Maximum time (in seconds) between consecutive digests of info (BOC and BTRY).
- MIN TIME DIGEST- Minimum time (in seconds) between consecutive digests of info (BOC and BTRY).

LOST TIME	-	Time (in seconds) after which a track not seen is assumed permanently lost (BOC and BTRY).
LAST CHANCE	-	Time (in seconds) considered short for a subordinate to respond to a target. (Time from now until his last chance to shoot.) BOC only, for BTRY = 0.
ENGAGE WINDOW	-	Minimum length of subordinates engagement window for a significant engagement opportunity in seconds (BOC and BTRY).
MODVAL 2	-	Model Value = 0
MODVAL 3	-	Model Value = 0
COVONONE	-	Desired number of fire units coverage for one aircraft (BOC and BTRY).
ONE	-	Model Value = 1
COVONFEW	-	Desired number of fire units coverage for few aircraft (BOC and BTRY).
FEW	-	Model Value = 5, number of aircraft considered "few."
COVONMANY	-	Desired number of fire units coverage for many aircraft (BOC and BTRY).
MANY	-	Model Value = 1000000.
TIMEFLIGHT	-	Maximum time (in seconds) of flight for missile (BOC and BTRY).
MISSILE RANGE	-	Maximum range for missiles in meters (BOC and BTRY).

MAXASSIGN	-	Maximum number of targets per ready fire unit to be assigned at one time. BOC only, for BTRY = 0.
MODVAL 4	-	Model Value; for BOC = 8, BTRY = 11.
MODVAL 5	-	Model Value = 0
MAX TRACK RANGE	-	Maximum tracking range in meters. BTRY only, for BOC = 0.
LOCK ON TIME	-	Assumed time (in seconds) for BTRY achieve lockon. BTRY only, for BOC = 0.
MODVAL 6	-	Model Value = 0.
MODVAL 7	-	Model Value = 0.
CONVLOAD	-	Number of conventional missiles.
SNUKELOAD	-	Number of small nukes.
LNUKELOAD	-	Number of large nukes.
RESUPPLYCV	-	Number of missiles per resupply of ammo. BTRY only, for BOC = 0.
CVRESUPPLYFREQ	-	Time (in seconds) between resupply of conventional ammo. BTRY only, for BOC = 0.
RESUPPLYSN	-	Number of missiles per resupply of small nukes. BTRY only, BOC = 0.
SNRESUPPLYFREQ	-	Time (in seconds) between resupply of small nukes. BTRY only, BOC = 0.
RESUPPLYLN	-	Number of missiles per resupply of large nukes. (BTRY only, BOC = 0).

LNRESUPPLYFREQ	-	Time (in seconds) between resupply of large nukes. BTRY only, BOC = 0.

i) <u>DIB</u>

TIME	-	Side of target (DIL).
NUMAL	-	
LOST	-	Code when target is lost.
POSITION	-	Positon of target.
HEADING	-	Heading of target (DIL).
VELOCITY	-	Velocity of target.
ALTITUDE	-	Altitude of target.

j) <u>PERLIST</u>

PUP	-	Pointer to the PERLIST block which is an up pointer in the perceptions list.
PDOWN	-	Pointer to the PERLIST block which is a next pointer in the perceptions list.
PSB	-	Pointer to the BOC's scoreboard.
PDIL	-	Pointer to the DIL block which is associated with it.
SEEN	-	Code to show seeing status of the target. 0 - Can not see and has not been assigned. 1 - Early warning, has been assigned by superior. 2 - Can see target.
PSS	-	Pointer to the SOURCE block which is a list of subordinates that can see the target.
PUPCHN	-	
PDNCHN	-	

TIME	-	Time that the target was last seen.

k) <u>SOURCE</u>

PSB	-	Pointer to the SCOREBOARD block which is the scoreboard of the subordinate that can see the target.
PNEXT	-	Pointer to the SOURCE block which is the next subordinate in the list that can see the target.

e. <u>Linkages to Other Data Structures</u>

The BOC structures are linked to the command and control tree by the C2 block of the BOC.

f. <u>Notes</u>

7. SAM BATTERY (BTRY)

a. Data Block Index

ABSITEDB

ALLOCATE

BTRYDIL

BTRYSTAT

C^2

DIB

FIREUNT

PATENGAGE

PERLIST

SB

SDB

b. Description

The air defense information for the SAM Battery (BTRY) in MADEM is stored in the Battery Digested Information List (BTRYDIL). The fireunits of a Battery are allocated to the BTRYDILS to create the Threat-Defense Allocation Structure for each Battery.

The BTRYDIL represents the perceived threat to the Battery and is pointed to from the Battery's Status Board (BTRYSTAT). The list of fireunits of the Battery are pointed to from the Battery Status Display Board (SDB). The fireunits are the Battery's subordinates and the number of fireunits are limited depending on the type of Battery it is. A Hawk battery can have at most two fireunits where a Herc battery can have only one. When a fireunit is allocated to a threat, BTRYDIL, an ALLOCATE block is created to link the two together. Note that at most there can only be one allocation block for any one fireunit, but a threat, BTRDIL, could have multiple allocation blocks. This does not hold for the last Battery type, the PATRIOT. A PATRIOT does not have any fireunits as subordinates, it has a known engagement capacity. The number of engagements can be allocated to one or multiple threats, BTRYDILS. When a PATRIOT engagement is allocated to a threat a PATENGAGE block is created.

The BTRYDILS are devided up into three different DIL configurations; (1) Active DIL list, (2) TRACKED DIL list, (3) Force out queue. This allows the threats, DILS, to be handled in a systematic way. All the DIL configurations are pointed to from the BTRYSTAT.

The Active DIL (ADIL) is a doublylinked circular list of all the threats actively being considered by the Battery. The DIL's in the ADIL are considered one at a time in the list, in increments controlled by the Scheduled Digest event. The Air Defense Data Base controls the maximum number of DIL's a Battery can have in it's ADIL.

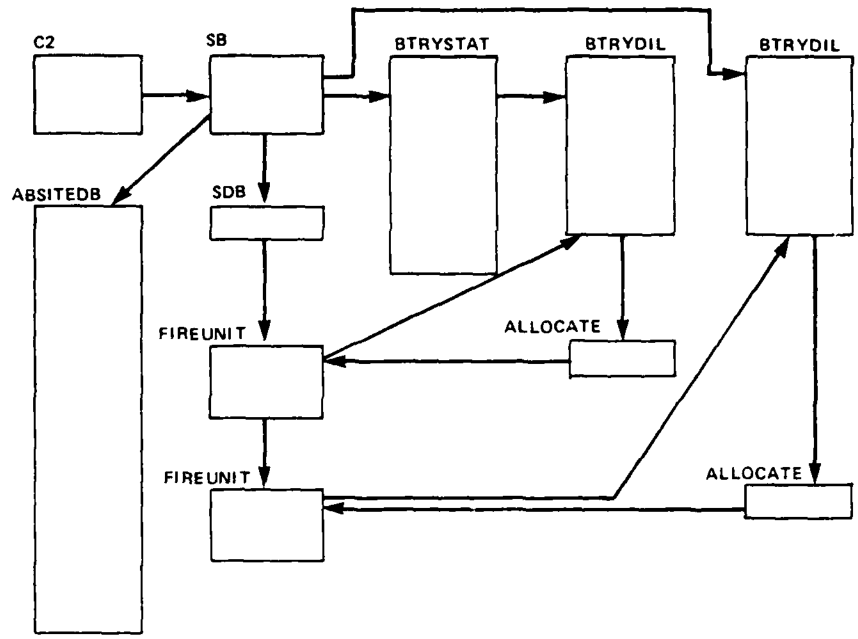
When a Battery fully assigns the responsibility of a threat DIL to it's subordinates, the DIL is taken out of the ADIL and put into the TRACKED DIL list. The Tracked List is a doubly linked list of DIL blocks with a pointer to the head of the list.

If a DIL in the ADIL is forced out becuase the need to bring in a DIL of a higher priority, it is put in the Force Out Queue (FOQ). The FOQ is a doubly linked list with a head and tail pointer to the list. This is an overflow list and the DIL will eventually be brought back into the ADIL when there is an opening. The head and tail pointers allow access from either end of the list to get the best DIL out of the FOQ.

Each DIL has an associated Digested Information Block (DIB) with it. This holds the current information that the BOC has on the target. When the DIL is in the Active DIL List a new DIB is created and compared to the old one each time the DIL target is examined. The DIL's are also associated with the Perceptions List, a PERLIST block from the Perceptions List and a DIL are linked up. The information in the PERLIST is from the Perception event and is used with the DIL to represent the information on a target.

c. Structure Overview

1. Structure Diagram (Figure III-30, III-31, III-32, III-33)



4368/79W

Figure III-30. SAM Battery Structure Diagram (HAWK and HERC)

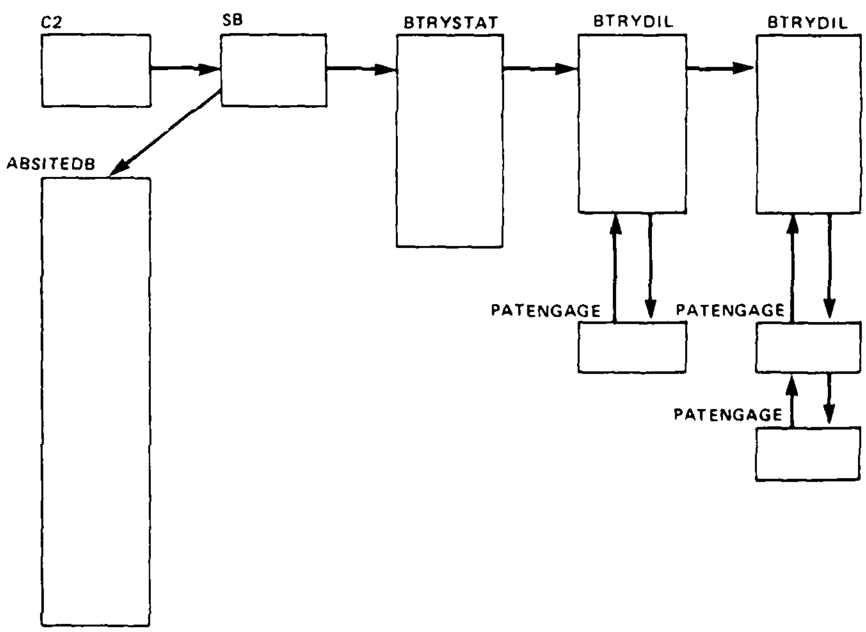


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Figure III-31. SAM Battery Structure Diagram (PATRIOT)

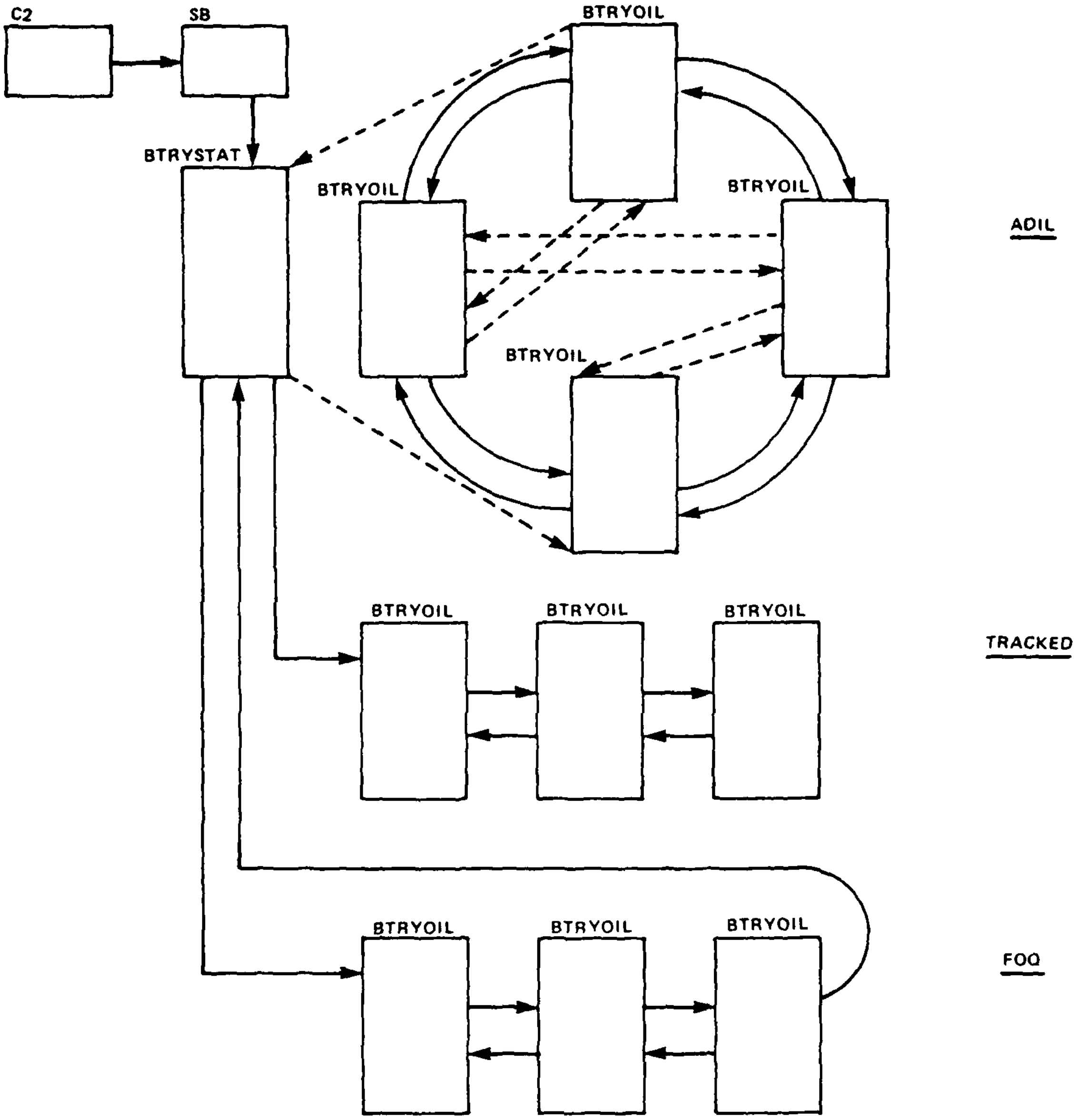
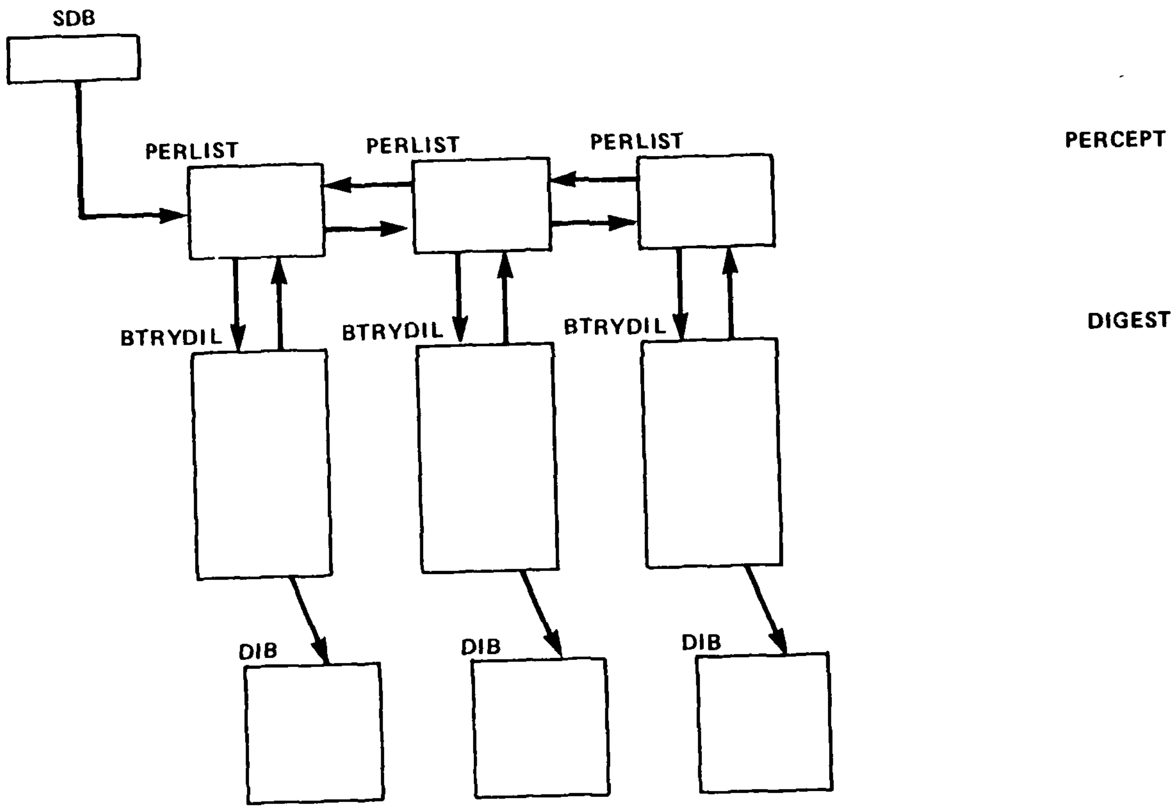


Figure III-32. BTRYDIL Configurations

4368/79W



4368/79W

Figure III-33. Battery BTRYDIL Perception List Association

d. <u>Block Specifications</u>

1) <u>Block Diagrams</u>

a) C^2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

b) SB

ADDRESS	PC2
PSDB	PFEL
PACQ	IO
DATABASE	PBOCSTAT

c) SDB

PSB	PSEEBUF
SUBORDINATE	ORD

d) FIREUNIT

AMMO	PNEXT
PDIL	STAGE
CEASE	PENGEV
CAMMO	BUSV
NIAMMO	N2AMMO

e) BTRYSTAT

AUTO	NUM
PSDIG	PSDELY
PADIL	NADIL
PHFOQ	PTFOQ
PHNDIL	PTNDIL
HPRIOR	IPRIOR
TRACTED	IDLE
PHDAQ	PTDAQ
PTL	A1
RESUPPLY	A2
AMTDT	NUMENG
NUCNO	A3

f) BTRYDIL

PUP	PDOWN
PPERC	PDIB
LOC	PRIORITY
PRIUP	PRIDN
DCOV	SHORT
PDELAY	PENGEV
PAL	NUKE
CEASE	ASSIGN
TRACK	FIRE
START (SPACE)	
END (SPACE)	

g) ALLOCATE

PUP	PPDOWN
AMMOTYPE	PFU

h) ADSITEDB

PNEXT	ADTYPE
MODVAL1*	MAXNUMDIGEST
MAXTIMEDIGEST	MINTIMEDIGEST
LOSTTIME (SPACE)	
ENGAGEWINDOW (SPACE)	
MODVAL2 (SPACE)	
MODVAL3 (SPACE)	
COVONONE	ONE
COVONFEW	FEW
COVONMANY	MANY
TIMEFLIGHT (SPACE)	
MISSILE RANGE (SPACE)	
MAXASSIGN MODVAL4	
MODVAL5 (SPACE)	
MAXTRACKRANGE (SPACE)	
LOCKONTIME (SPACE)	

MODVAL6 (SPACE)	
MODVAL7 (SPACE)	
CONVLOAD	
SNUKELOAD	LNUKELOAD
RESUPPLYCV	CVRESUPPLYFREQ
RESUPPLYSN	SNRESUPPLYFREQ
RESUPPLYLN	LNRESUPPLYFREQ

i) PATENGAGE

PUP	PDOWN
PDIL	STAGE
CEASE	PENGEV

j) DIB

TIME(SPACE)	
SIDE	NUMAL
LOST	POSITION
HEADING (SPACE)	
VELOCITY (SPACE)	
ALTITUDE (SPACE)	

k) PERLIST

PUP	PDOWN
PSB	PDIL
SEEN	PSS
PULPCHN	PDNCHN
TIME (SPACE)	

2) Field Definitions

a) C2 Block

UNITMUNBER - Number of the unit. If negative the unit is a passing target.

PUP - Pointer to the C^2 block of the unit's commander.

PDOWN - Pointer to the C^2 block of the unit's subordinate.

PNEXT	-	Pointer to the C^2 block of the unit's sibling.
PSB	-	Pointer to the SB block of the unit.
UNITTYPE	-	The unit's type code (see subsection f)
SIDE	-	Unit affiliation. 1 = Blue (NATO) 2 = Red (PACT)

b) <u>SB BLOCK</u>

ADDRESS	-	Pointer to HEX block of the HEX in which the unit is located.
PC2	-	Pointer to C^2 block of the unit.
PSDB	-	Pointer to the SDB block of the unit.
PFEL	-	Pointer to future event list EVENT block.
PACQ	-	Pointer to ACQBUF block. Used by CRC's for acquisition devices.
ID	-	Identification number
DATABASE	-	If BOC or BTRY points to ADSITEDB block.
PBOCSTAT	-	Points to BOCSTAT block if the unit is a battalion operations center.

c) <u>SDB BLOCK</u>

PSB	-	Pointer to the Unit's SB block.
PSEEBUF	-	Pointer to SEEBUF block which is used by aircraft flight units to record targets seen and their perceived damage levels. This field definition is used only by flights.

	SUBORDINATE	-	Points to FIREUNIT block which is a list of subordinate fire units.
	ORD	-	Points to ORDERS block if the unit is a flight.
d)	AMMO	-	
	PNEXT	-	Pointer to the FIREUNIT block of the subordinate fireunits sibling.
	PDIL	-	Pointer to the BTRVDIL block associate with this battery fireunit.
	STAGE	-	
	CEASE	-	
	PENGEV	-	
	CAMMO	-	
	BUSY	-	
	NIAMMO	-	
	N2AMMO	-	
e)	BTRYSTAT		
f)	BTRYDIL		
	PUP	-	Pointer to the BTRYDIL block which is the previous entry in the DIL chain.
	PDOWN	-	Pointer to the BTRYDIL block which is next entry in the DIL chain.
	PPERC	-	Pointer to the PERLIST block which is the entry in the perceptions list for this DIL.

PDIB	-	Pointer to the DIB block which is the digested information block holding information about the target.
LOC	-	The code to tell which DIL configuration this DIL is located in Code: 0 - Active DIL list 1 - Force out queue 2 - Tracked list
PRIORITY	-	Priority of this flight as a target.
PRIUP	-	Pointer to the BTRYDIL block which is the head of the priority chain within the active DIL list.
PRIDN	-	Pointer to the BTRYDIL block which is the tail of the priority chain within the active DIL list.
DCOV	-	Desired coverage on this flight.
SHORT	-	Shortfall from desired coverage: short - DCOV (DESIRED COVERAGE) - Allocated.
PDELAY	-	Pointer to the DAQE block which is the delayed action queue, a list of delayed action for this track.
PENGEV	-	Pointer to the EVENT block
PAL	-	Pointer to the ALLOCATE block which is the allocations list for this tracked target, holds the list of all fire units allocated to a target.

NUKE	-	Flags target NUKE/NoNUKE.
CEASE	-	'cease' marker
ASSIGN	-	
TRACK	-	Flag: 1 - waiting to track 2 - untrackable 0 -
FIRE	-	Waiting to fire flag
START	-	Starting window
END	-	End window

g) <u>ALLOCATE</u>

PUP	-	Pointer to the ALLOCATE block which is the previous entry in the list of allocations.
PDOWN	-	Pointer to the ALLOCATE block which is the next entry in the list of allocations.
AMMOTYPE	-	
PFU	-	Pointer to the FIREUNIT block which is the fire unit associated with this allocation.

h) <u>ADSITEDB BLOCK</u>

PNEXT	-	Pointer to next ADSITEDB block.
ADTYPE	-	Unit type of this unit, must be a BOC or BTRY.
MODVAL 1	-	Model value = 1
MAXNUM DIGEST	-	Maximum number of flights on which a BOC or BTRY can be digesting info at one time.
MAXTIMEDIGEST	-	Maximum time (inseconds) between consecutive digests of into (BOC & BTRY).

MINTIMEDIGEST	-	Minimum time (in seconds) between consecutive digests of into (BOC & BTRY)
LOSTTIME:	-	Time (in seconds) after which a track not seen is assumed permanently lost (BOC & BTRY).
LASTCHANCE	-	Time (in seconds) considered short for subordinate to respond to a target. (time from now until his last chance to shoot). BOC only, for BTRY = 0.
ENGAGE WINDOW	-	Minimum length of subordinates engagement window for a significant engagement opportunity in seconds (BOC & BTRY).
MODVAL 2	-	Model Value = 0
MODVAL 3	-	Model value = 0
COVONONE	-	Desired number of fire units coverage for one aircraft (BOC & BTRY)
ONE	-	Model value = 1
COVONFEW	-	Desired number of fire units coverage for few aircraft (BOC & BTRY)
FEW	-	Model value = 5, number of aircraft considered "few".
COVONMANY	-	Desired number of fireunits coverage for many aircraft (BOC & BTRY).
MANY	-	Model value = 1000000.
TIMEFLIGHT	-	Maximum time (in seconds) of flight for missile (BOC & BTRY)

MISSILE RANGE	-	Maximum range for missiles in meters (BOC & BTRY).
MAXASSIGN	-	Maximum number of targets per ready fire unit to be assigned at one time. BOC only, for BTRY = 0.
MODVAL 4	-	Model value; for BOC = 8, for BTRY = 11.
MODVAL 5	-	Model value = 0.
MAX TRACK RANGE	-	Maximum tracking range in meters. BTRY only, for BOC = 0.
LOCK ON TIME	-	Assumed time (in seconds) for BTRY to achieve lockon. BTRY only, for BOC = 0.
MODVAL 6	-	Model value = 0.
MODVAL 7	-	Model Value = 0.
CONVLOAD	-	Number of conventional missiles.
SNUKELOAD	-	Number of large nukes.
LNUKELOAD	-	Number of large nukes.
RESUPPLYCV	-	Number of missiles per resupply of ammo. BTRY only, for BOC = 0
CVRESUPPLYFREQ	-	Time (in seconds) between resupply of conventional ammo. BTRY only, for BOC = 0.
RESUPPLYSN	-	Number of missiles per resupply of small nukes. BTRY only, BOC = 0.
SNRESUPPLYFREQ	-	Time (in seconds) between resupply of small nukes. BTRY only, BOC = 0.
RESUPPLYLN	-	Number of missiles per resupply of large nukes. (BTRY only, BOC = 0.

LNRESUPPLYFREQ	-	Time (in seconds) between resupply of large nukes. BTRY only, BOC = 0.

i) <u>PATENGAGE</u>

PUP	-	Pointer to the PATENGEGE block which is the previous entry in the list of PATENGAGES below the BTRYDIL.
PDOWN	-	Pointer to the PATENGAGE block which is the next entry in the list of PATENGAGES below the BTRYDIL.
PDIL	-	Pointer to the BTRYDIL block associated with this PATENGAGE.
STAGE	-	
CEASE	-	
PENGEV	-	Pointer to the EVENT block.

j) <u>DIB</u>

TIME	-	
SIDE	-	Side of target (DIL)
NUMAL	-	
LOST	-	Code when target is lost.
POSITION	-	Position of target
HEADING	-	Heading of target (DIL)
VELOCITY	-	Velocity of target
ALTITUDE	-	Altitude of target

k) <u>PERLIST</u>

PUP	-	Pointer to the PERLIST block which is an up pointer in the perceptions list.
PDOWN	-	Pointer to the PERLIST block which is a next pointer in the perceptions list.

PSB	-	Pointer to the DIL block which is associated with it.
SEEN	-	Code to show seeing status of the target 0 - can not see, and has not been assigned 1 - early warning, has been assigned by superior 2 - can see target
PSS	-	Not used with battery, only BOC
PUPCHN	-	
PDNCHN	-	
TIME	-	Time that the target was last seen

e. Linkages to other Data Structures

The battery structures are linked to the command and control tree by the C^2 block of the battery.

f. Notes

8. PASSIVE TARGETS (PT)

a. Data Block Index

C^2

SB (modified)

b. Description

The PASSIVE TARGET LIST is made up of C^2 and associated CB blocks which are in a linked list. This list is separate from the C^2 TREE and is used to represent blue units which are non-players. These blue target units are non-players in the sense that they merely act as objectives for red attacks.

Passive target units are characterized by negative unit numbers in their C^2 blocks and a modified SB block which has three rather than the usual four words. The configuration of the passive target list is shown in the structure diagram.

c. Structure Overview

1) Structure Diagram Figure III-34)

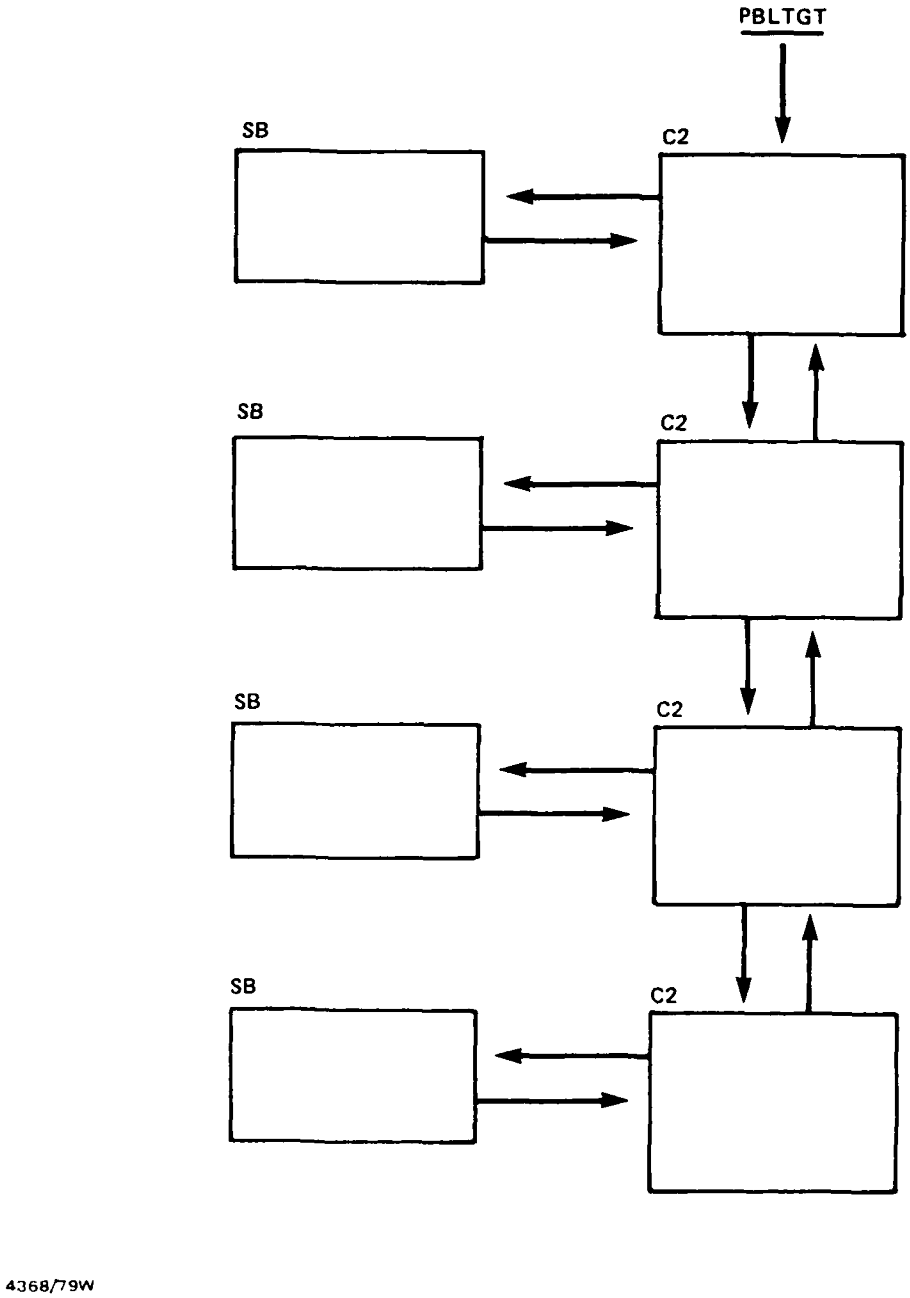


Figure III-34. Passive Target List Structure Diagram

2) Block Definitions

C^2 - COMMAND/CONTROL BLOCK. Contains list pointers, a negative unit number, pointer to SB, unit type code and side.

The usual four words. Contains pointers to C^2 and HEX blocks.

d. Block Specifications

1) Block Diagrams

a) C^2

UNITNUMBER	
PUP	PDOWN
PSB	PNEXT
UNITTYPE	SIDE

b) SB (MODIFIED)

ADDRESS	PC2
CUMLTA IV DAMAGE	
PACQ	ID

2) Field Definitions

a) C^2 BLOCK

UNITNUMBER - Number of the unit. If negative the unit is a passive target.

PUP - Pointer to the C^2 block of the unit's commander.

PDOWN - Pointer to the C^2 block of the unit's subordinate.

PNEXT - Pointer to the C^2 block of the unit's sibling.

PSB - Pointer to the SB block of the unit.

UNITTYPE - The unit's type code (see subsection f)

SIDE	-	Unit affiliation. 1 = Blue (NATO) 2 = Red (PACT)

b) SB BLOCK

ADDRESS	-	Pointer to HEX block of the hex in which the unit is located.
PC2	-	Pointer to C^2 block of the unit.
CUMLTIVDAMAGE	-	Cumulative damage to target.
PACQ	-	Pointer to ACQBUF block. Used by CRC's for acquisition devices. (not used)
ID	-	Identification number.

e. Linkages to Other Data Structures

The PASSIVE TARGET LIST is used exclusively for targeting by the red planning module. Its only external linkage is to the HEX block in which the unit is located.

f. Notes

H. STORAGE SPACE MANAGEMENT

1. Data Block Index

Assorted unnamed unMIDASized blocks released from active use for data storage.

2. Description

Storage space in the dynamically allocated array ISPACE (131000) is carried out using the routines GIMME and RELEASE. GIMME is used to allocate storage blocks in ISPACE. Given the desired block length in words, GIMME first searches the Garbage Collection Matrix structure (illustrated in the structure diagrams) for a previously allocated but now released block of the desired length. If no block is found in the matrix, GIMME accesses NEW SPACE (Free Space) using the ESPTR pointer and allocates the desired block. If there is no space available, GIMME stops the simulation and issues a STORAGE SPACE OVERFLOW message.

RELEASE is used to construct the Garbage Collection Matrix. When a block is no longer required, GIMME is called with the length of the block to be released. RELEASE then adds the used block to the appropriate list in the matrix. The array ICTGIM(20) is used to count the number of released blocks in each size list. Blocks greater than or equal to 20 words in length are counted in element 20 of ICTGIM.

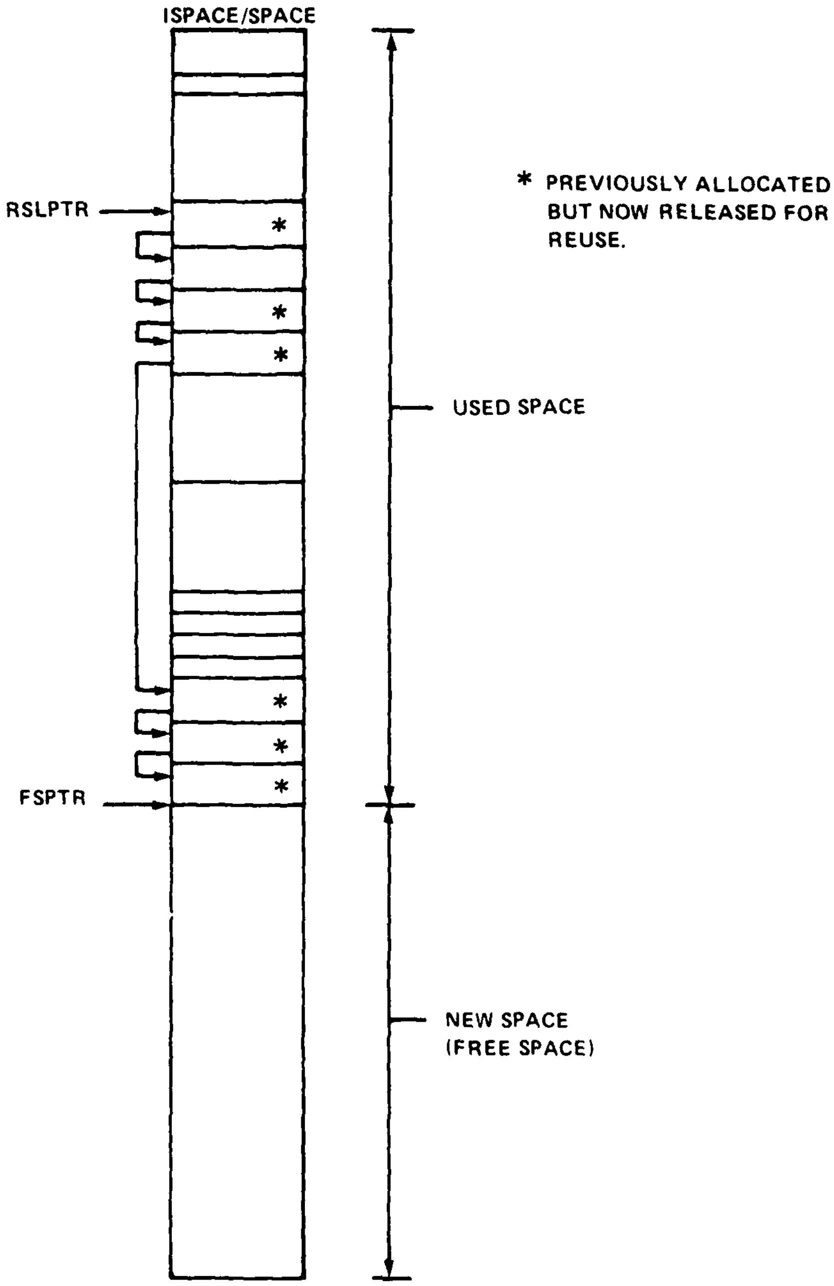
3. Structure Overview

a. Structure Diagrams (See Figures III-35 and III-36)

b. Block Definitions

BLKLENTH — BLOCK SIZE LIST BUFFER BLOCK. Contains a block length field, a pointer to the list of BLK blocks of the specified length and a pointer to the next BLKLENTH block for the n next size SIZE LIST.

BLK — RELEASED BLOCK. Storage block which has been released for further use. Contains a pointer to the next BLK block in its SIZE LIST. All remaining words initialized to zero (Ø).



RSLPTR – POINTER TO (ADDRESS OF) GARBAGE COLLECTION MATRIX
FSPTR – POINTER TO (ADDRESS OF) FREE SPACE

4368/79W

Figure III-35. I-Space Array Configuration

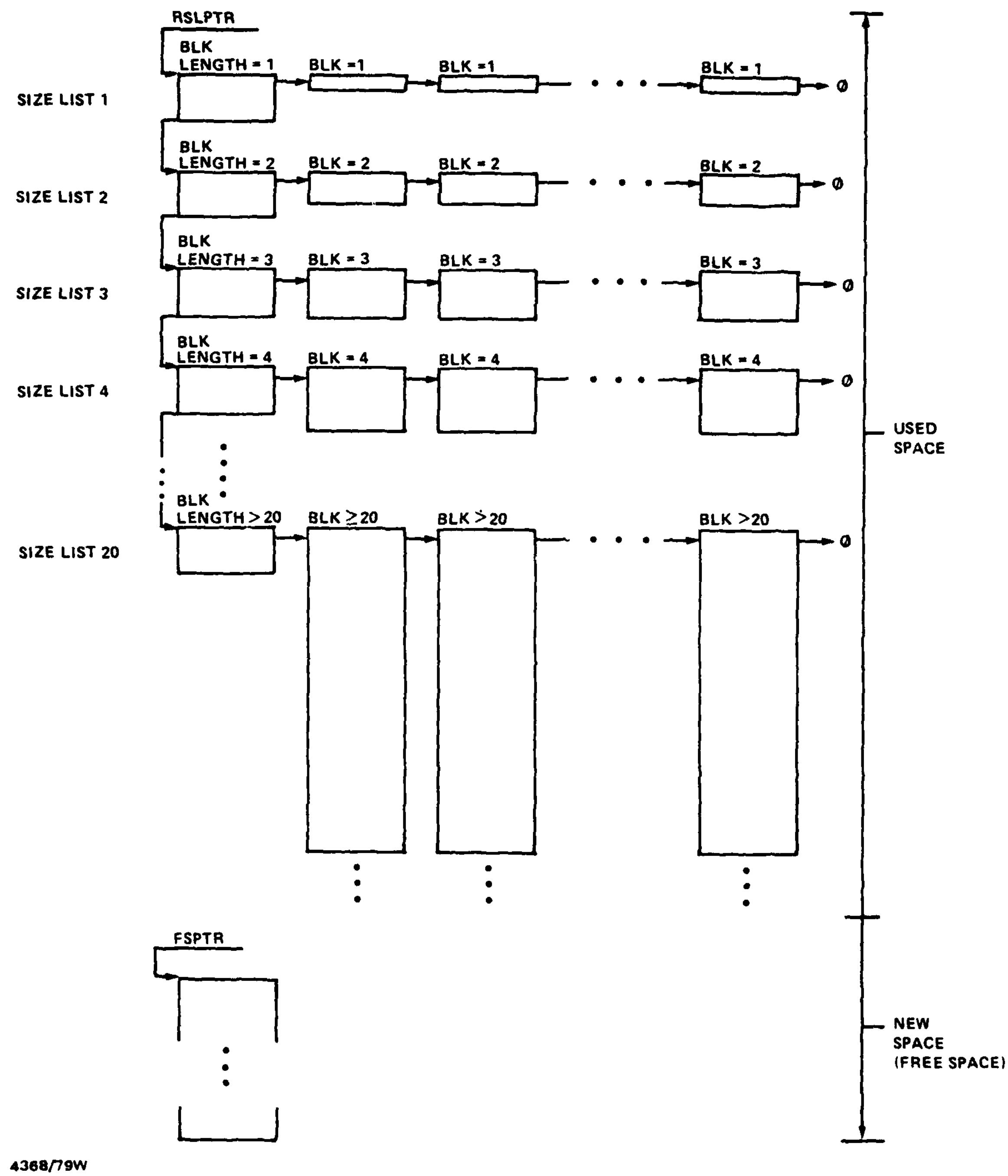


Figure III-36. Garbage Collection Matrix Structure Diagram

4. Block Specifications

a. Block Diagrams

1) BLKLENGTH

BLOCKLENGTH

PTRBLOCK

PTRNEXT

2) BLK

PTRNEXT

Ø

Ø

Ø

Ø VARIABLE LENGTH

o

o

o

b. Field Definitions

1) BLKLENGTH Block

BLOCKLENGTH	Length of BLK blocks on list (in words).
PTRBLOCK	Pointer to first BLK block in the list.
PTRNEXT	Pointer to next BLKLENGTH block.

2) BLK Block

PTRNEXT	Pointer to next BLK block in the size list.

5. Linkages to Other Data Structures

All other data structures are built using storage blocks from either the GARBAGE MATRIX or FREESPACE.

6. Notes

APPENDIX A

EXECUTION REQUIREMENTS

MADEM ON THE AFWL SYSTEM

MADEM uses either of 2 computers at AFWL, the Y mainframe (MFY) or the X mainframe (MFX). Both are CDC cyber 176 machines. We generally run on MFY since our data 100 has a direct line there, but we can run on either. It is possible to use a dial up terminal for either batch or interactive service using the following phone numbers:

BAUD RATE	MFY	MFX
300	505-264-2082 (3)	505-842-5162 (17)
300	--	505-842-9980 (10)
300	--	505-264-5875 (3)
300	--	505-265-9861 (3)
1200	505-264-5840 (3)	505-264-5705
1200	505-264-7812 (3)	--
4800	505-842-6392 (2)	505-842-6391 (4)
4800	--	505-842-5711 (6)

The number in parenthesis is the number of lines on that rotary.

USING THE DATA 100

The Data 100 (JB-5C) remote batch terminal has a direct line going to AFWL's MFY.

To Bring up the Data 100:

1. Load Emulator - Red in "Data 100" cards by pressing "HALT", then "LOAD". After cards have been read press "RUN".
2. Press Xmit button - Xmit light on is for Ø29 keypunch.
3. Wait for "Data Link" Light
4. Before entering each command, press control-A.
5. Type "LOGIN, SGCBDM, WDNA14V6, SUP (or L5 for V6)
6. Wait for "COMMAND" message.
7. Type "C".

To Enter Cards:
1. Load Cards
2. Press Start
3. Type "R" When Reader stops.

To Turn on Line Printer Type "ON,LP"

AFWL JOB CARD (1st Card in Deck)

Example: WBDMBSM, ST176, T40, J037, P66.

WBDMBSM - Can be any name, 1st 5 CHARS used as 1st 5 CHARS of 7 CHAR job name.

ST176	-	Tells it to run on either CYBER176 (MFY or MFX). Can also use STMFX or STMFY to run on a particular machine.
T4Ø	-	CPU time limit in OCTAL seconds.
I037	-	IO time limit in OCTAL seconds.
P66	-	Request for 66 priority. The highest priority allowed is dependent on IO+CPU time requested.

P66 IO+CPU $\underline{L}$ 100 OCTAL
P60 IO+CPU $\underline{L}$ 400 OCTAL
P50 IO-CPU $\underline{L}$ 1,000 OCTAL

<u>AFWL ACCOUNT CARD</u> (2nd Card in Deck)

Example: Account BSMBDM, WDNA14V6-SGC, BDM, 703-821-4223.

Account	-	Card Identifier
BSMBDM	-	Means Nothing
WDNA14V6	-	Account
SGC	-	Password
BDM	-	Not needed, but it identifies us
703-821-4223	-	Not needed, but is phone number of user in case the need to call user.

MADEM PERM FILES AT AFWL

PERM FILE NAME	COMMENTS
MADEM INITBIN	CURRENT INITBIN BINARY FILE
MADEM RUNBIN	CURRENT RUNBIN BINARY FILE
MADEM HISTBIN	CURRENT HISTBIN BINARY FILE
DATFILE AAA	DATFILE INPUT FOR AAA RUN
DATFILE TEST 1	DATFILE INPUT FOR TEST RUN
UOIL AAA	UOIL INPUT FOR AAA RUN
UOIL TEST 1	UOIL INPUT FOR TEST RUN
MIDASTABLE SOURCE	SOURCE FOR FULL MIOAS TABLE
MADEM IDAS TABLES	GENERATED MIDAS TBLES
ICOMPBIN	CURRENT BINARY FOR COMPARE 2ISPACES
NIPULSTOR	BINARY FOR NIPUL8TOR-DEBUG ROUTINE
KOMMONBIN	BINARY FOR COMMON ANALYZER
MADEM ONE PLAN 1 AAA	HOLD FILE LAST MADEM I INITBIN AAA RUN
MADEM ONE PLAN 2 AAA	HOLD FILE FROM CAST MADEM F AAA INITBIN RUN
MADEMONE INITBIN	MADEM I INITBIN BINARY, (UP TO M1)
MADEM ONE RUNBIN	MADEM I RUNBIN BINARY, (UP TO M1)
MADEM ONE HISTBIN	MADEM I RUNBIN BINARY, (UP TO M1)
MADEM TWORNITBIN	MADEM II INITBIN BINARY
MADEM TWO RUNBIN	MADEM II RUNBIN BINARY

LARGE PERM FILES AT AFWL

Any perm file larger than 35 RB's (1960 PRU's) will be routinely purged at AFWL.

1 PRU	=	64 Words
1 RB	=	56 PRU's = 3,584 Words
35 RB's	=	125,440 Words

Theoretically, one can have a large perm file saved at AFWL if it is approved by Airman Vickers.

To have a perm file over 35 RB's saved write to:

Airman Richard Vickers
AFWL LADPO
Kirtland AFB
New Mexico 87117
(505) 264-7984

With the following information:

1. Justification for the large file
2. How long the file is to be saved
3. The name of the file
4. Your account number
5. The cycle numbers of that file to be protected.

To give a better probability to your request being approved send a cc to:

Pat Smari — She works in the software consultine office and has
AFWL/ADSD — promised to help us to get approval. Kirtland AFB
New Mexico 87117
(505) 264-0831

REGISTERING TAPES AT AFWL

AFWL Owned Tapes

To rent an AFWL owned tape simply call the AFWL Tape Librarian at:
(505) 264-0225

Have prepared the same information as is needed when sending a BDM tape (see below).

BDM Owned Tapes

If you don't have a tape, get one from Phuoy and send it to:

AFWL/ADPO
Kirtland ABF
New Mexico 87117
Attention: EXPEDITOR

Include the following information:

1. A 1Ø-character tape name beginning with BDMV, C.I.E. BDMUMADEM 6)
2. The tape density
3. Number of tracks on tape
4. Your phone number (they will call with the USN)

MADEM TAPES

VSN	TAPE NAME	TRACK	DENS	OWNED BY	LOCATION	DATE ACQUIRED	CONTAINS
JH66		NT	HD	BDM	BDM		MADEM I SOURCE
JH67		NT	HD	BDM	BDM		MADEM I SOURCE
JH68		NT	HD	BDM	BDM		MADEM I PL
BC59		MT	HY	AFWL	AFWL		MADEM II PL
BC87		MT	HY	AFWL	AFWL		MADEL II PL
AB31	BDMUMADEM 1	MT	HY	AFWL	AFWL	7/79	MADEM III PL-BACKUP
AB33	BDMUMADEM 2	MT	HY	AFWL	AFWL	7/79	MADEM III PL-BACKUP
AD78	BDMUMADEM 3	MT	HY	BDM (24090)	AFWL	7/79	MADEM I PL-MOST RECENT 8/11/79
AD87	BDMUMADEM 4	MT	HY	BDM (24091)	AFWL	7/79	MADEM III PL-BACKUP
AI36	BDMUMADEM 5	MT	HY	AFWL	AFWL	8/79	MADEM III PL-CURRENT
AI76	BDMUMADEM 6	MT	HY	AFWL	AFWL	9/79	NOT USED.

NT = NINE TRACK HD = 800 CPI PL = PROGRAM LIBRARY
MT = SEVEN TRACK HY = 800 BPI

AFWL ACCOUNTING
JULY 27, 1979

HRLY RATES

	SYSTEM	CONNECT
MFB	170/HR	$5/HR, 7 A.M.-7 P.M.
MFX,	700/HR	$10/HR, 7 A.M.-7 P.M.

BILLING BASED ON SYSTEM RECORDS
PERMFILE STORAGE FREE

BILLING QUESTIONS

Mr. Elsberrid (505) 264-0831
(CALL OR WRITE FOR DAY FILES)

AFWL/ADS
Attention: Consulting Office
Kirtland AFB
New Mexico 87117

In Particular call on accounting program errors for monthly bills call Dan Thornburg at (505) 264-0208.

HOW TO RUN MADEM

MADEM is currently set up to run on either the X or Y mainframe at AFWL.

To run MADEM you need on perm files:

1. UOIL (input data)
2. DATFILE (input data)
3. INITBIN (pre-processor binary file)
4. RUNBIN (main binary file)
5. HISTBIN (post-processor binary file)

MADEM is run in 3 stages; the middle stage is generally run in 6 to 12 steps, or volumes.

The 3 stages must be run in the following order: INITBIN, then RUNBIN once for each volume, then HISTBIN.

The complete run will result in 2 printouts plus one printout (the event trace) for each volume.

See Figure 1 for a run diagram, and the JCL listings for examples of JCL desks used for a run.

INITBIN

INITBIN is MADEM's pre-processor. It processes the DATFILE and UOIL, and then plans the red raid, all the while initializing 1 space and the common blocks. The 2 hold files save 1 space and the common blocks for subsequent volume runs. INITBIN also output's a history file for the post-processor.

The Binary file INITBIN is stored on a perm file under the name 'MADEM-INITBIN' for MADEM III.

INITBIN INPUT:

1. DATFILE - Tape 8 - Perm File name is 'DATFILEAAA'
2. UOIL - Tape 7 - Perm File name is 'UOILAAA'
3. Input deck with parameters:
   Card 1: (Unformatted, Mandatory)
      Parm 1 - must be INTEGER 1 for INITBIN
      Parm 2 - INTEGER, size of 1 space (max) during INITBIN
      Parm 3 - Max number of players on either side
      Parm 4 - Not used in INITBIN, max CPU time (real)
   Card 2: To the last card:
      The second set of options are all optional. Each of these parms must begin on column 1Øx+1, where x=(Ø7). There may be from 1 to 8 RARMS per card, with as many cards as are necessary
      Parms:

'DEBUG=ON'	-	Turns on printing or subroutine trace messages.
'DUMP=ON'	-	Will dump 1 space at end of run.
DATFLE=ON'	-	Turns on display of DATFILE DATA structure
'STOP=ODAT'	-	Stop INITBIN after DATFILE
'STOP=UOIL'	-	Stops INITBIN after semant (UOIL)
'STOP=DEL'	-	Stop INITBIN after DELADD, before executing plan event.

INITBIN OUTPUT:

1. 2 Hold files with 1 space, common blocks (Tape 10, Tape 11)
2. 1 File for history processing (Tape 4)
3. Printout, which includes:
   1) Plan of red raid
   2) Datfile structure pointers
   3) UOIL ECHOS:
      - commander-subordinate relationships
      - hex number for each unit, RED and BLUE
      - primary target line (PTL) values for each applicable BLUE unit
      - discription of corridor block
      - hex and C^2 pointers for each unit, RED and BLUE

4) Common block dump
5) Other data, according to parameters, which may include:
   - subroutine trace messages
   - 1 space dump
   - data structure dumps

Perm Files Names for INITBIN output:

TAPE 1Ø	-	PLAN 1 AAA
TAPE 11	-	PLAN 2 AAA
TAPE 4	-	HSTPLAN AAA

```
WBDMBSM,ST176,T1177,Io177,P60,EC200.   MADEM INITBIN RUN (AAA)
ACCOUNT BSMBDM,WDNA14V6-SGC,BDM,703-821-4223.   B. MACALEER
COMMENT. ***************************************
COMMENT. *                                     *
COMMENT. * MADEM  INITBIN RUN:                 *
COMMENT. *    READS DATFILE, UOIL INPUT        *
COMMENT. *    GENERATES ISPACE                 *
COMMENT. *    PLANS RED RAID                   *
COMMENT. *    SAVES ISPACE ON HOLD FILES       *
COMMENT. *    SAVES COMMON BLOCKS ON HOLD FILES*
COMMENT. *                                     *
COMMENT. * FILES:                              *
COMMENT. *    TAPE4  - HISTORY FILE            *
COMMENT. *    TAPE6  - PRINTED OUTPUT          *
COMMENT. *    TAPE7  - UOIL INPUT              *
COMMENT. *    TAPE10 - FIRST HOLD FILE         *
COMMENT. *    TAPE11 - SECOND HOLD FILE        *
COMMENT. *    TAPE14 - PRINTED OUTPUT          *
COMMENT. *                                     *
COMMENT. ***************************************
REQUEST,TAPE4,*PF.
REQUEST,TAPE10,*PF.
REQUEST,TAPE11,*PF.
ATTACH,TAPE7,UOIL78A,ID=WDNA14V6.
ATTACH,TAPE8,CDAT78A,ID=WDNA14V6.
ATTACH,XBIN,MADEMINITBIN,ID=WDNA14V6,MR=1.
LDSET,PRESET=ZERO,MAP=SBEX.
LOAD,XBIN.
EXECUTE.
DMP,100,7200.
REWIND,TAPE4.
REWIND,TAPE6.
REWIND,TAPE10.
REWIND,TAPE11.
REWIND,TAPE14.
COMMENT. ***************************************
COMMENT. * SAVE HOLD FILES, HISTORY FILE       *
COMMENT. ***************************************
CATALOG,TAPE10,PLAN1AAA,ID=WDNA14V6,RP=999.
CATALOG,TAPE11,PLAN2AAA,ID=WDNA14V6,RP=999.
CATALOG,TAPE4,HSTPLANAAA,ID=WDNA14V6,RP=999.
COMMENT.
COPYBF,TAPE14,OUTPUT.
COPEBF,TAPE6,OUTPUT.
AUDIT.ID=WDNA14V6.
COMMENT. ***************************************
COMMENT. * IF WE BOMBED, GET OUTPUT ANYWAY     *
COMMENT. ***************************************
EXIT.
```

```
DMP,100,7200.
REWIND,TAPE14.
COPYBF,TAPE14,OUTPUT.
REWIND,TAPE6.
COPYBF,TAPE6,OUTPUT.
COMMENT.
AUDIT,ID=WDNA14V6.
COMMENT. ***************************************
COMMENT. *                                     *
COMMENT. * FIRST INPUT CARD IS MANDATORY AND   *
COMMENT. * HOLDS 4 PARAMETERS:                 *
COMMENT. *     1.  IOP - MUST BE 1 FOR INITBIN *
COMMENT. *     2.  MSPCE - SIZE OF ISPACE      *
COMMENT. *     3.  MAX NO. PLAYERS ON ONE SIDE *
COMMENT. *     4.  MAX CPU TIME OF THIS RUN    *
COMMENT. *                                     *
COMMENT. * THE SECOND INPUT CARDS ARE OPTIONAL *
COMMENT. * AND CAN HOLD THESE PARMETERS:       *
COMMENT. *     DEBUT=ON - SUBROUTINE TRACE     *
COMMENT. *           MESSAGES ARE PRINTED      *
COMMENT. *      DUMP=ON - WILL DUMP ISPACE     *
COMMENT. *    DATFLE=ON - WILL DISPLAY DATFILE *
COMMENT. *    STOP=ODAT - STOPS INITBIN AFTER  *
COMMENT. *      PROCESSING DATFILE,BEFORE UOIL *
COMMENT. *    STOP=UOIL - STOPS AFTER UOIL     *
COMMENT. *     STOP=DEL - STOPS AFTER DELADD   *
COMMENT. *                                     *
COMMENT. ***************************************
&        EOR
1,50000,600,90.
DEBUG=ON
DUMP=ON
DATFLE=ON
STOP=ODAT
#        EOI
```

RUNBIN

A full production run is generally accomplished in volumes, but may be done in one run if desired. The length of a volume is controlled by the fourth input parameter, which tells MADEM how much CPU time to use before stopping. Using 90 seconds, most MADEM runs take six to twelve volumes. The hold files between each volume are saved so that the user can rerun any given volume. This is done by changing the 'ATTACK' and 'CATALOG' cards (in the JCL deck) after each volume run. The hold files are numbered within the Perm File name to identify the volume that created them. For example, files AAAV10, AAAV11, AAAV12, and AAAV13 are hold files created by volume 1. The 'AAA' stands for run type AAA. There are currently input files on cards for 5 runs, called Runs AAA, BBB, CCC, DDD, and EEE.

Perm File Name for RUNBIN: 'MADEMRUNBIN'

RUNBIN INPUT:

1. 4 Hold files - TAPE15, TAPE16, TAPE17, TAPE18.
   (For a Volume 1 Run use only TAPE15 and TAPE16).
2. Input deck with parameters:
   Card 1:
   - PARM 1 - Must be INTEGER '2' for RUNBIN
   - PARM 2 - INTEGER, MAX size of ISPACE
   - PARM 3 - INTEGER, MAX number of players on either side.
   - PARM 4 - Real, MAX CPU time of volume (in seconds)

   Card 2 to the last card:
   - Same as INITBIN, but only DUMP=ON and DEBUG=ON are effective parameters.

RUNBIN OUTPUT:
1. 4 Hold files - TAPE10, TAPE11, TAPE12, TAPE13
2. TAPE4 - for the post processor
3. Event trace listing (printed)
4. Common block dump (printed)
5. DEBUG messages (if chosen)
6. ISPACE 'DUMP' (if chosen)

```
WBDMBSM,ST176,T177,IO177,P60,EC400.   MADEM PRODUCTION RUN (AAA)
ACCOUNT BSMBDM,WDNA14V6-SGC,BDM,703-821-4223.   B.MACALEER
COMMENT. ************************************
COMMENT. *                                  *
COMMENT. * MADEM PRODUCTION RUN             *
COMMENT. *                                  *
COMMENT. * FILES:                           *
COMMENT. *    TAPE4   - HISTORY FILE        *
COMMENT. *    TAPE6   - PRINTED OUTPUT      *
COMMENT. *    TAPE10  - FIRST HOLD FILE     *
COMMENT. *    TAPE11  - SECOND HOLD FILE    *
COMMENT. *    TAPE12  - THIRD HOLD FILE     *
COMMENT. *    TAPE13  - FOURTH HOLD FILE    *
COMMENT. *    TAPE14  - PRINTED OUTPUT      *
COMMENT. *                                  *
COMMENT. ************************************
REQUEST,TAPE4*PF.
REQUEST,TAPE10,*PF.
REQUEST,TAPE11,*PF.
REQUEST,TAPE12,*PF.
REQUEST,TAPE13,*PF.
COMMENT.
ATTACK,BIN,MADEMRUNBIN,ID=WDNA14V6,MR=1.
LDSET,PRESET=ZERO.
LOAD,BIN.
EXECUTE,,PL=20000.
REWIND,TAPE4.
REWIND,TAPE6.
REWIND,TAPE10.
REWIND,TAPE11.
REWIND,TAPE12.
REWIND,TAPE13.
REWIND,TAPE14.
COMMENT. ************************************
COMMENT. *SAVE ISPACE, COMMONS              *
COMMENT. *SAVE TAPE4 FOR HISTORY PROCESSING *
COMMENT. ************************************
CATALOG,TAPE10,AAAV10,ID=WDNA14V6,RP=999.
CATALOG,TAPE11,AAAV11,ID=WDNA14V6,RP=999.
CATALOG,TAPE12,AAAV12,ID=WDNA14V6,RP=999.
CATALOG,TAPE13,AAAV13,ID=WDNA14V6,RP=999.
CATALOG,TAPE4,HSIAAAV1,ID=WDNA14V6,RP=999.
COMMENT.
DMP,100,7200.
COMMENT. ************************************
COMMENT. *TAPE14 USUALLY NULL               *
COMMENT. ************************************
COPYBF,TAPE14,OUTPUT.
COMMENT.
```

```
COMMENT. *************************************
COMMENT. *TAPE6 HAS EVENTS, DUMPS (IF ANY)     *
COMMENT. *************************************
COPYBF,TAPE6,OUTPUT.
COMMENT.
AUDIT,ID=WDNA14V6.
COMMENT. *************************************
COMMENT. * IF WE BOMB, PRINT OUTPUT ANYWAY     *
COMMENT. *************************************
EXIT.
DMP,100,7200.
REWIND,TAPE14.
COPYBF,TAPE14,OUTPUT.
REWIND,TAPE6.
COPYBE,TAPE6,OUTPUT.
AUDIT,ID=WDNA14V6.
COMMENT. *************************************
COMMENT. *                                     *
COMMENT. * FIRST INPUT CARD IS MANDATORY AND   *
COMMENT. * HOLDS 4 PARAMETERS:                 *
COMMENT. *     1.  IOP - MUST BE 2 FOR RUNBIN  *
COMMENT. *     2.  MSPCE - SIZE OF ISPACE      *
COMMENT. *     3.  MAX NO. PLAYERS ON ONE SIDE *
COMMENT. *     4.  MAC CPU TIME OF THIS RUN    *
COMMENT. *                                     *
COMMENT. * THE SECOND INPUT CARDS ARE OPTIONAL *
COMMENT. * AND CAN HOLD THESE PARAMETERS:      *
COMMENT. *     DEBUG=ON  - SUBROUTINE TRACE    *
COMMENT. *         MESSAGES ARE PRINTED        *
COMMENT. *     DUMP=ON   - WILL DUMP ISPACE    *
COMMENT. *                                     *
COMMENT. *************************************
&        EOR
2,131000,600,90.
DEBUG=ON
DUMP=ON
#        EO1
```

CARDS FOR VOLUMES:

```
COMMENT.
COMMENT. **************************************
CINEBT, * VOLUME 2, RUN TYPE AAA             *
COMMENT. **************************************
COMMENT.
ATTACH,TAPE15,AAAV10,ID=WDNA14V6.
ATTACH,TAPE16,AAAV11,ID=WDNA14V6.
ATTACH,TAPE17,AAAV12,ID=WDNA14V6.
ATTACH,TAPE18,AAAV13,ID=WDNA14V6.
CATALOG,TAPE10,AAAV20,ID=WDNA14V6,RP=999.
CATALOG,TAPE11,AAAV21,ID=WDNA14V6,RP=999.
CATALOG,TAPE12,AAAV22,ID=WDNA14V6,RP=999.
CATALOG,TAPE13,AAAV23,ID=WNDA14V6,RP=999.
CATALOG,TAPE4,HSTAAAV2,ID=WNDA14V6,RP=999.
COMMENT.
COMMENT. **************************************
COMMENT. *VOLUME 3, RUN TYPE AAA              *
COMMENT. **************************************
COMMENT.
ATTACH,TAPE15,AAAV20,ID=WDNA14V6.
ATTACH,TAPE16,AAAV21,ID=WDNA14V6.
ATTACH,TAPE17,AAAV22,ID=WDNA14V6.
ATTACH,TAPE18,AAAV23,ID=WDNA14V6.
CATALOG,TAPE10,AAAV30,ID=WDNA14V6,RP=999.
CATALOG,TAPE11,AAAV31,ID=WDNA14V6,RP=999.
CATALOG,TAPE12,AAAV32,ID=WDNA14V6,RP=999.
CATALOG,TAPE13,AAAV33,ID=WDNA14V6,RP=999.
CATALOG,TAPE4,HSTAAAV3,ID=WDNA14V6,RP=999.
COMMENT.
COMMENT. **************************************
COMMENT. *VOLUME 4, RUN TYPE AAA              *
COMMENT. **************************************
COMMENT.
ATTACH,TAPE15,AAAV30,ID=WDNA14V6.
ATTACH,TAPE16,AAAV31,ID=WDNA14V6.
ATTACH,TAPE17,AAAV32,ID=WDNA14V6.
ATTACH,TAPE18,AAAV33,ID=WDNA14V6.
CATALOG,TAPE10,AAAV40,ID=WDNA14V6,RP=999.
CATALOG,TAPE11,AAAV41,ID=WDNA14V6,RP=999.
CATALOG,TAPE12,AAAV42,ID=WDNA14V6,RP=999.
CATALOG,TAPE13,AAAV43,ID=WDNA14V6,RP=999.
CATALOG,TAPE4,HSTAAAV4,ID=WDNA14V6,RP=999.
COMMENT.
COMMENT. **************************************
COMMENT. *VOLUME 5,RUN TYPE AAA               *
COMMENT. **************************************
COMMENT.
ATTACH,TAPE15,AAAV40,ID=WDNA14V6.
```

```
ATTACH,TAPE16,AAAV41,ID=WDNA14V6.
ATTACH,TAPE17,AAAV42,ID=WDNA14V6.
ATTACH,TAPE18,AAAV43,ID=WDNA14V6.
CATALOG,TAPE10,AAAV50,ID=WDNA14V6,RP=999.
CATALOG,TAPE11,AAAV51,ID=WDNA14V6,RP=999.
CATALOG,TAPE12,AAAV52,ID=WDNA14V6,RP=999.
CATALOG,TAPE13,AAAV53,ID=WDNA14V6,RP=999.
CATALOG,TAPE4,HSTAAAV5,ID=WDNA14V6,RP=999.
COMMENT.
COMMENT. ***************************************
COMMENT. * VOLUME 6, RUN TYPE AAA              *
COMMENT. ***************************************
COMMENT.
ATTACH.TAPE15,AAAV50,ID=WDNA14V6
```

HISTBIN

After all volumes have been run, the post processor can be run to summarize the outcome of events.

PERM FILE name of BINARY FILE: HISTBIN

INPUT:

(1) TAPE4 - A concatenation of all post-processor (history) files which includes exactly one file for each volume plus one file from INITBIN
(2) Two card input deck of PARMS, as in JCL example.

OUTPUT:

Printed summary of the MADEM RUN.

NOTE: Little is known about HISTBIN AT THIS TIME.

```
WBDMBSM,ST176,T177,10177,P60.    MADEM HISTORY PROCESSING
ACCOUNT BSMBDM,WDNA14V6-SGC,BDM,703-821-4223.  B.MACALEER
ATTACH,LGO,MADEMHISTBIN,ID=WDNA14V6,MR=1.
ATTACH,PLAN,HSTPLANAAA,ID=WDNA14V6.
ATTACH,V1,HSTAAAV1,ID=WDNA14V6.
ATTACH,V2,HSTAAAV2,ID=WDNA14V6.
ATTACH,V3,HSTAAAV3,ID=WDNA14V6.
ATTACH,V4,HSTAAAV4,ID=WDNA14V6.
ATTACH,V5,HSTAAAV5,ID=WDNA14V6.
ATTACH,V6,HSTAAAV6,ID=WDNA14V6.
ATTACH,V7,HSTAAAV7,ID=WDNA14V6.
ATTACH,V8,HSTAAAV8,ID=WDNA14V6.
ATTACH,V9,HSTAAAV9,ID=WDNA14V6.
COPYBR,PLAN,TAPE4.
COPYBR,V1,TAPE4.
COPYBR,V2,TAPE4.
COPYBR,V3,TAPE4.
COPYBR,V4,TAPE4.
COPYBR,V5,TAPE4.
COPYBR,V6,TAPE4.
COPYBR,V7,TAPE4.
COPYBR,V8,TAPE4.
COPYBR,V9,TAPE4.
REWIND,TAPE4.
LDSET,PRESET=ZERO.
LOAD,LGO.
EXECUTE.
REWIND,TAPE4.
COPYSBF,TAPE4,OUTPUT.
AUDIT,ID=WDNA14V6.
EXIT.
AUDIT,ID=WDNA14V6.
&        EOR
CONVENTIONAL   1978   AAA   LEVEL 2 PK
39000.,999999999.,999999999.,999999999.,999999999.
#        EOI
```

RUNBIN

A full production run is generally accomplished in volumes, but may be done in one run if desired. The length of a volume is controlled by the fourth input parameter, which tells MADEM how much CPU time to use before stopping. Using 90 seconds, most MADEM runs take six to twelve volumes. The hold files between each volume are saved so that the user can rerun any given volume. This is done by changing the 'ATTACK' and 'CATALOG' cards (in the JCL deck) after each volume run. The hold files are numbered within the Perm File name to identify the volume that created them. For example, files AAAV10, AAAV11, AAAV12, and AAAV13 are hold files created by volume 1. The 'AAA' stands for run type AAA. There are currently input files on cards for 5 runs, called Runs AAA, BBB, CCC, DDD, and EEE.

Perm File Name for RUNBIN: 'MADEMRUNBIN'

RUNBIN INPUT:

1. 4 Hold files - TAPE15, TAPE16, TAPE17, TAPE18.
   (For a Volume 1 Run use only TAPE15 and TAPE16).
2. Input deck with parameters:
   Card 1:
   - PARM 1 - Must be INTEGER '2' for RUNBIN
   - PARM 2 - INTEGER, MAX size of ISPACE
   - PARM 3 - INTEGER, MAX number of players on either side.
   - PARM 4 - Real, MAX CPU time of volume (in seconds)

   Card 2 to the last card:
   Same as INITBIN, but only DUMP=ON and DEBUG=ON are effective parameters.

RUNBIN OUTPUT:

1. 4 Hold files - TAPE10, TAPE11, TAPE12, TAPE13
2. TAPE4 - for the post processor
3. Event trace listing (printed)
4. Common block dump (printed)
5. DEBUG messages (if chosen)
6. ISPACE 'DUMP' (if chosen)

```
WBDMBSM,ST176,T177,IO177,P60,EC400.   MADEM PRODUCTION RUN (AAA)
ACCOUNT BSMBDM,WDNA14V6-SGC,BDM,703-821-4223.   B.MACALEER
AUDIT,ID=WDNA14V6.
COMMENT.
COMMENT. **************************************
COMMENT. * PURGE INITBIN'S OUTPUT FILES       *
COMMENT. **************************************
COMMENT.
PURGE,PLAN1,PLAN1AAA,ID=WDNA14V6,LC=1.
PURGE,PLAN2,PLAN2AAA,ID=WDNA14V6,LC=1.
PURGE,HSTPLANAAA,ID=WDNA14V6,LC=1.
COMMENT. **************************************
COMMENT. *PURGE VOLUME 1 OUTPUT FILES         *
COMMENT. **************************************
PURGE,AAAV10,ID=WDNA14V6,LC=1.
PURGE,AAAV11,ID=WDNA14V6,LC=1.
PURGE,AAAV12,ID=WDNA14V6,LC=1.
PURGE,AAAV13,ID=WDNA14V6,LC=1.
PURGE,HSTV1,HSTAAAV1,ID=WDNA14V6,LC=1.
COMMENT. **************************************
COMMENT. *PURGE VOLUME 2 OUTPUT FILES         *
COMMENT. **************************************
PURGE,AAAV20,ID=WDNA14V6,LC=1.
PURGE,AAAV21,ID=WDNA14V6,LC=1.
PURGE,AAAV22,ID=WDNA14V6,LC=1.
PURGE,AAAV23,ID=WDNA14V6,LC=1.
PURGE,HSTV2,HSTAAAV2,ID=WDNA14V6,LC=1.
COMMENT. **************************************
COMMENT. *PURGE VOLUME 3 OUTPUT FILES         *
COMMENT. **************************************
PURGE,AAAV30,ID=WDNA14V6,LC=1.
PURGE,AAAV31,ID=WDNA14V6,LC=1.
PURGE,AAAV32,ID=WDNA14V6,LC=1.
PURGE,AAAV33,ID=WDNA14V6,LC=1.
PURGE,HSTV3,HSTAAAV3,ID=WDNA14V6,LC=1.
COMMENT. **************************************
COMMENT. * PURGE VOLUME 4 OUTPUT FILES        *
COMMENT. **************************************
PURGE,AAAV40,ID=WDNA14V6,LC=1.
PURGE,AAAV41,ID=WDNA14V6,LC=1.
PURGE,AAAV42,ID=WDNA14V6,LC=1.
PURGE,AAAV43,ID=WDNA14V6,LC=1.
PURGE,HSTV4,HSTAAAV4,ID=WDNA14V6,LC=1.
COMMENT. **************************************
COMMENT. * PURGE VOLUME 5 OUTPUT FILES        *
COMMENT. * ************************************
PURGE,AAAV50,ID=WDNA14V6,LC=1.
PURGE,AAAV51,ID=WDNA14V6,LC=1.
PURGE,AAAV52,ID=WDNA14V6,LC=1.
```

```
PURGE,AAAV53,ID=WDNA14V6,LC=1.
PURGE,HSTV5,HSTAAAV5,ID=WDNA14V6,LC=1.
COMMENT. ************************************
COMMENT. * PURGE VOLUME 6 OUTPUT FILES        *
PURGE,AAAV60,ID=WDNA14V6,LC=1.
PURGE,AAAV61,ID=WDNA14V6,LC=1.
PURGE,AAAV62,ID=WDNA14V6,LC=1.
PURGE,AAAV63,ID=WDNA14V6,LC=1.
PURGE,HASTV6,HSTAAAV6,ID=WDNA14V6,LC=1/
AUDIT,ID=WDNA14V6.
&        EOR
#        EOI
```

The MIDAS BIN code is called "MIDAS' on account BDMAFM at AFWL.

JCL: MIDAS, COMPILE, XXX. this run a file called 'COMPILE' (generally the output from UPDATE) through MIDAS and puts the compilable fortran code into a file XXX. The default for XXX is FTNOUT.

OPTION: PL=nnn where nnn=line limit of FTNOUT FILE. Default: nnn=5,000.

MADEM MIDAS TABLES

(1) "4" Data Structures
(2) All Data Structures

PROGRAM LIBRARY DECK NAME CHANGES

The following subroutines were listed in decks on the program library whose deck name did not match the subroutine name. The deck names have been changed to match the subroutine names. In some MADEM I and MADEM II listings. However, these routines are filed under the old deck name.

SUBROUTINE	OLD DECK NAME	NEW DECK NAME
AB2CRC	ABMSG	AB2CRC
BNCONTC	NBNCONT	BNCONTC
BNLALLE	NBNLALL	BNALALLE
BTN2CRC	BTNMSG	BTN2CRC
BYALCOV	PROCCLU	BYALCOV
BYCONTC	NBYCONT	BYCONTC
BYTKCHK	NBYTKCH	BYTKCHK
CRC2INT	INTASIN	CRC2INT
HANDZPT	NHANDZP	HANDZPT
INRANGE	NINRANG	INRANGE
INTASIN	BADASIN	INTASIN
INT2CRC	INTMSG	INT2CRC
RELOCAT	NRELOC	RELOCAT
SAMPRCM	NSAMPRC	SAMPRCM
TRKCHEK	NTRKCHE	TRKCHEK

The only remaining subroutines that do not occupy a deck of the same name are the UOIL routines in decks ULSUB2 and UOILSUB.

STRAY SUBROUTINES

The following subroutines reside in the noted deck on the program library. These routines are standard UOIL routines, and need not be altered for MADEM. These routines are represented on our master list by deck name, and may be filed as such in the books.

DECK UOILSUB	DECK ULSUB2
APCEL1	ADDCHR
APCEL2	ERROR
CARD	EXTSCN
CHRGEN	LEXAN
LACELL	LOOKUP
NXTSYM	LRKPRS

APPENDIX B

MODULAR INFORMATION DATA ACCESS SYSTEM (MIDAS)

A. INTRODUCTION

MIDAS consists of two parts: the MIDAS language and the MIDAS Translator. The MIDAS language allows one to write programs using only the logical aspects of data structures. The MIDAS Translator reads data structure definitions and programs written in the MIDAS language, realizes the physical implementation of the logical data structures, and generates a FORTRAN program or subprogram as output.

The advantages of using MIDAS are twofold. First, the programmer is no longer concerned with the details of data structure implementation, and is free to use natural names for elements of the data structures. Second, a program written in MIDAS is easier to convert to another type of computer since the logical definition of the data structures do not change, only the physical implementation which is now completely mechanized.

The MIDAS Translator is controlled by a set of tables which define the logical data structures to be translated and their specific physical implementation. Thus, each programming project will utilize a different set of tables, corresponding to the data structures peculiar to that project.

The MIDAS Translator constructs these tables automatically using information supplied by the user. This definition information is expressed using a Data Structure Definition Language (DSDL) which defines the logical data structures and their physical implementation details. This language can also be used to uniquely specify and document the logical design of data structures during the preliminary and detailed design phases of a project.

B. THE DATA STRUCTURE DEFINITION LANGUAGE

Data structures are closely related to sets; therefore, we will use concepts and notations adapted from set theory for describing the logical aspects of data structures. A data structure contains members, in the

same way that a set has members (we are excluding the null set in this discussion since a data structure with no members, and hence no information, is not of practical value). We will assign unique names to all data structures. We may assign arbitrary names to the data structure members, provided we do not use any of the data structure names. Thus, for example, we can write:

A = (A1, A2, A3, A4)

B = (B1, B2, B3, B4, B5)

C = (DOG)

Here we have defined three data structures, A, B, and C, with members as shown.

We impose the restriction that a data structure member may not be a data structure. This means that the following definition is illegal:

A = (B, C)

B = (D, E)

This restriction is imposed by the current capability of the MIDAS Translator and is expected to be removed at a later date.

We also note that the logical definition of a data structure does not require the members to be ordered. For example, the following two definitions of data structure A are logically equivalent:

A = (B, C)

A = (C, B)

However, physical implementation of data structures using the MIDAS Translator will require that the members be ordered. Therefore, we will assume that the members are ordered for this reason. The order is that in which the members are listed in the data structure definition. Since there is only one definition for each data structure, there is no possibility of a conflict in order arising.

A member may have an attribute associated with it. The only attribute which will be permitted under the initial DSDL will be the pointer attribute. The pointer attribute specifies that the member is a pointer to a specified data strucutre. A member with the pointer attribute is denoted

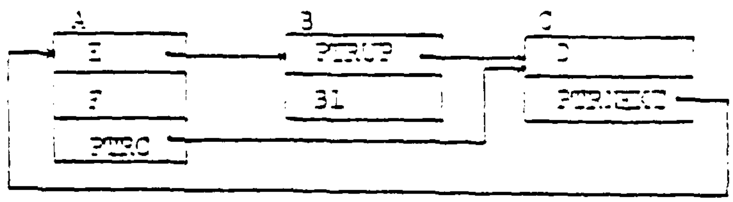
by the form A=*B, where A is the member name and B is the data structure which is pointed to by A. For example:

A = (E=*B, F, PTRC=*C)

B = (PTRUP=*C, B1)

C = (D, PTRNEXT=*A)

These definitions are equivalent to the following schematic representation:



Members which are data structure pointers always point to the data structure itself, not to any members of the data structure. This distinction is important to understand, since the entire MIDAS system is based on this convention. Thus, in the above example, member PTRC of data structure A points to data structure C, but not to member D of data structure C.

The above discussion treats only the logical aspects of data structure definition. In order for MIDAS to implement a data structure it is also necessary to specify the physical properties of the data structure. This is done for each member of the structure.

Each structure will be implemented in one or more words of storage. A member may occupy an entire word, or it may occupy a bit field within a word. In addition, the data structure itself is embedded within a FORTRAN structure such as an array or COMMON block. A means must be provided for specifying all of these physical properties.

DSDL will utilize a parenthesized notation to specify the physical properties of data structures. The FORTRAN structure which contains a logical data structure will be denoted as in the following example:

A(ISPACE) = (B, C, D)

This indicates that data structure A is physically contained within an array named ISPACE. Only onedimensional arrays may be used for FORTRAN structures with the current version of the MIDAS Translator.

Members of data structures are stored as one member per word, in the same order as the members are listed in the data strucutre definition, unless otherwise indicated. Thus, in the above example, data structure A requires three words of storage space, one each for B, C, and D.

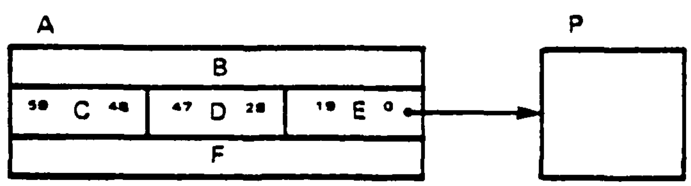
It may be desirable to pack several members into the same word, with a specific bit field allocated for each member within the word. All of the members which occupy the same physical word are enclosed by parentheses. For example:

A(ISPACE) = (B, (C, D, E), F)

Here data structure A requires three words of storage, but members C, D, and E are packed into the second word. We have shown how two or more members are packed, but we have not indicated the bit fields which contain them. Bit field designation is accomplished with an integer which specifies the number of consecutive bits in the field. This integer is enclosed in parentheses and immediately follows the member name (if the member name has an attribute, the bit field information follows the attribute information). For a given computer word, the bit fields are assigned in the order that members are specified, starting with the leftmost bit and proceeding to the right. It is not necessary that the bit space of the entire word be allocated. For example:

A(ISPACE) = (B, (C(12), D(28), E=*P(20)), F)

Assuming a 60 bit word, this data structure definition can be represented schematically as:



The Data Structure A is contained in array ISPACE. Data structure P, which is pointed to by member E of A may or may not be in ISPACE.

All data structure members which are bit packed are assumed to be accessed (in the FORTRAN sense) in the array name specified on the left hand side of the data structure definition statement. Normally, this

"default" array will be of integer type, since it is unlikely that a packed word will contain floating point data. On the other hand, other members of the same data strucutre which occupy entire words may be of a different number type, such as real, and therefore require access using a different FORTRAN array name.

The default array name can be overridden for a particular member by following the member name with the array name required by that member; this member array name is enclosed by parentheses and applies only to that specific member. This feature is applicable only to members which occupy entire words; all members which are bit packed automatically use the default array name. For example:

A(ISPACE) = (B(SPACE), (C(12), D(28), E=*P(20)), F)

C. TABLE GENERATION FOR THE MIDAS TRANSLATOR

Before the MIDAS Translator can be used to translate source programs written in the MIDAS language, it must be told how to interpret logical data structure references and implement them in FORTRAN. This is done by an input language which includes statements written in the Data Structure Definition Language along with other information. Using this input, the MIDAS Translator builds the translation tables from scratch, or, alternatively, augments a table which already exists.

Table construction or augmentation is known as Phase I operation of the MIDAS Translator. This phase is optional in a given MIDAS run, but must have been done at least once before midas source language programs can be translated.

Phase 1 operation is initiated by the appearance of a special input card which has one of two forms. If the translation tables are being constructed from scratch the initial card has the form:

/MIDAS dialect

Where dialect is one of the key words CDC, IBM, MULTICS, or UNIVAC.

Thus the dialect specifies a particular computer system for which the tables will be constructed. On the other hand, if additional data structure definitions are being added to previously generated tables, MIDAS already knows which computer system is required, and the initial card has the form:

/MIDAS

The MIDAS card is followed by information which defines the number type for all arrays which are being introduced for the first time in subsequent data structure definition statements; if an array has previously been introduced in an earlier Phase 1 run, MIDAS already knows its number type and respecification of number type for that array will not be allowed. The specification of array type is needed when tables are being built for either IBM or MULTICS dialect. For CDC and UNIVAC dialect the array type information is superfluous and need not be included.

The array type information is introduced with the card:

/TYPE

This is followed by one or more cards of array type specification; each card begins with the keyword REAL or INTEGER, followed by the names of the arrays of that type, using comma separators between array names. For example:

```
/TYPE
REAL SPACE, SCOREBOARD, QUEUE
INTEGER ISPACE, ISCORE
REAL QXR
```

The data structure definition block appears next. It is introduced by the card:

/DEFINE

which is followed by one or more cards containing data structure definitions, using the Data Structure Definition Language described in the previous section.

Following the data structure definition block the user may include an optional macro definition block. This block is introduced by the card:

/MACRO

which is followed by one or more macro definitions. Each macro definition is introduced by a card containing the macro name enclosed by $ characters. This is then followed by one or more card images which contain the actual macro text. The macro text may be arbitrary except that the first character on any macro text card can not be a $ or /. For example:

```
/MACRO
$SUE$
THIS IS A MACRO
$MARY$
MARY HAD
A
LITTLE
     MACRO
```

In this example two macros, SUE and $MARY$, are defined.

The end of the input for Phase 1 operation is the card:

/END

Note that the only required input cards for Phase 1 operation are /MIDAS and /END. All other input is optional, however, at least one definition block must be included, as introduced by /TYPE, /DEFINE, or /MACRO.

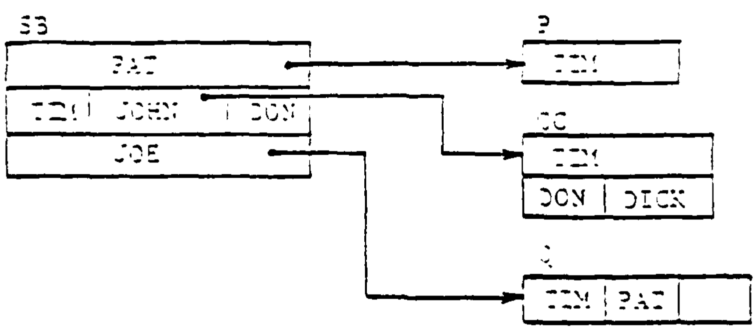
If a previously generated table is being augmented, only additions are permitted to the table. No previously defined information may be changed or redefined.

D. THE MIDAS LANGUAGE

In order to illustrate the MIDAS language we define a set of data structures which will be used in conjunction with an extended example. The definitions are written using the input language for Phase 1 operation of the MIDAS Translator:

```
/MIDAS CDC
/DEFINE
SB(ABC) = (PAT=*P, (TIM(30), JOHN=*CC(10), DON(20)), JOE=*Q)
CC(XYZ) = (TIM, (DON(30), DICK(30)))
Q(AAA) = ((TIM(20), PAT(30))
P(BB) = (TIM)
/MACRO
$SUE$
     INTEGER ABC
     DATA IDEBUG/0/
/END
```

These data structures have the following schematic representation:



Next we present a MIDAS subroutine which exhibits all of the features of the MIDAS language:

```
1        SUBROUTINE PDQ (B,C,JIM,BILL,BOB)
2        COMMON/ARRAYS/ABC(1000),XYZ9500),AAA(200),BBB(700)
3        DECLARE JIM=SB, K
4        DECLARE J, BILL = CC
5        DECLARE BOB = SB
6        $SUE$
7        $J=JIM$
8        $K=BOB.PAT$
9   100  A=B*C+J*K
10       B=$J.JOE.PAT$
11  200  $K.TIM$=3+$K.TIM$*5/$BILL.DON$
12       RETURN
13       END
```

This subroutine is not intended to represent meaningful computation but only to serve as an example of the use of the MIDAS language. The lines of the subroutine are numbered to permit easy referencing in the discussion which follows.

The arrays which contain the data structure SB, CC, Q, and P must be available within the subroutine since they will be referenced by the FORTRAN subroutine generated by the MIDAS Translator. This is accomplished through the COMMON statement in line 2. The arrays could also have been established through the parameter list or with DIMENSION statements.

The data structures SB, CC, P, and Q are actually prototypes or templates. In practice, there will probably be many copies of a given type of data structure in use. The individual copies are distinguished from each other by the use of different pointers for each copy. Thus, we need a means of associating a particular pointer name with the type of data structure which it is pointing to. This is done with the DECLARE statement.

In line 3 we declare the FORTRAN variable JIM to be a pointer to a data structure of type SB. Similarly, in line 5 we declare BOB to also be a pointer to a data structure of type SB. JIM and BOB may point to the same instance of SB or to different instances. In line 4 we declare BILL to be a pointer to a data structure of type CC. It is necessary to establish values for JIM, BOB, and BILL before each of them is first used in a MIDAS data structure reference. In this example, these values are passed through the parameter list.

Given the name of a pointer to a data structure, we can now locate and reference the value of any member within that data structure. This is done by constructing a compound name, enclosed in $ symbols, using the (.) period symbol to separate elements of the compound name. For example, we can reference the member JOHN in data structure SB, using JIM as a pointer to SB, by the notation $JIM.JOHN$. This provides us with the actual value of JOHN. Since JOHN is a pointer to a data structure of type CC, we can then refer to member DICK of CC by the notation $JIM;JOHN;DICK$.

It is useful to have a means of working with partial compound names by establishing intermediate pointer values. This avoids having to unravel a long compound name each time the name is used, with the corresponding space and time penalties in the executing program. This can be accomplished using a pointer macro. A pointer macro establishes a MIDAS name for a pointer value which has been derived by traversing a pointer chain through the data structures. Once defined, the pointer macro can then be used in place of the compound name which it represents.

Examples of the specification of pointer macros are shown in lines 7 and 8. As can be seen, the pointer macro definition consists of a simple replacement statement enclosed by $ symbols. The left side of the replacement statement is an integer FORTRAN variable; the right side is a simple or compound name representing a data structure pointer. On the right side the simple name or the first element of the compound name may be either a data structure pointer or a previously defined pointer macro.

Once defined, a pointer macro may not be redefined. The definition remains to the end of the program or subprogram. Also, a pointer macro

must be defined before it is used. This requires that the definition card physically must precede any cards which use the pointer macro in the MIDAS source deck, and that the pointer macro definition statement must be executed before any statements which reference the pointer macro in the actual program execution.

In line 8 we define the pointer macro K as representing the string BOB.PAT; this will actually generate a FORTRAN variable K which contains the value of $BOB.PAT$, so that K may subsequently be used in the normal FORTRAN sense. However, since K also represents the string BOB.PAT, we note that the reference $K.TIM$ is identical to the reference $BOB.PAT.TIM$, as shown in line 11.

Similarly, we are substituting the MIDAS name J for JIM (and consequently the value of FORTRAN variable J is set to the value of FORTRAN variable JIM) as shown in line 7. This permits us to write the MIDAS name $J.JOE.PAT$ in line 10, which is equivalent to $JIM.JOE.PAT$.

Whenever a name is to be used as a pointer macro, this fact must be noted in a DECLARE statement. This is done by simply including the name in the list for a DECLARE statement such as is done in lines 3 and 4 for K and J, respectively. Individual items in a DECLARE statement list are separated by commas as shown.

MIDAS also permits the user to employ card macro definitions. A reference to a card macro is shown in line 6 and consists of the macro name (e.g., SUE) enclosed in $ symbols. The macro reference must not start in columns 1 through 6. Whenever a card macro is encountered, MIDAS will replace the macro with a set of one or more 80 column card images which correspond to the macro name. These card images may not contain any non-FORTRAN (i.e., MIDAS) text, since the card images are not interpreted by the MIDAS translator. The END card must not be included within the macro card set. The card macro may occur anywhere before the END card, there may be as many different card macros as desired, and the same card macro may appear several times.

There are some restrictions on ordering of MIDAS information. As discussed earlier, pointer macro definitions must precede any use of that

pointer macro both in card sequence and execution sequence. Also, the DECLARE statement must precede the use of any item specified in that DECLARE statement.

Whenever an END card is encountered, signifying the end of a subprogram, all definitions local to that subprogram as expressed on DECLARE cards and through pointer macro definition statements are lost. Other subprograms may follow and will be processed in sequence, but they must establish their own local definitions.

A word about number types: Names chosen for pointers to data structures and macro pointers (as specified in DECLARE statements) will have an identical FORTRAN name. Since these names represent pointers, they would be chosen so that they start with letters I through N. Otherwise, it will be necessary to type them as INTEGER using a TYPE statement.

E. USING THE MIDAS TRANSLATOR

The MIDAS Translator is a cross-translator, i.e., it is capable of generating output for several different computing systems including the system it operates on. Furthermore, MIDAS is designed to operate on all of the computing systems for which it is capable of providing translation output. These systems are CDC 6000/7000/Cyber series with FTN FORTRAN, IBM 360/370 series with FORTRAN Level G and H, Univac 1108 with FORTRAN V, and Honeywell MULTICS with FORTRAN.

The operating details depend in part upon the computing system on which the MIDAS Translator is operating. However, certain aspects of operation are common to all systems and will be discussed first.

1. General Operating Deatils

MIDAS Translator operation involves two phases. Phase 1 generates the MIDAS translation tables using the input language described in Section C. For a particular programming project and target computer a Phase 1 operation must be executed at least once. The tables which are generated may be saved as files and used for immediate or later translation of programs written in the MIDAS language. Furthermore, the tables may be augmented at any later time by additional Phase 1 operations.

Whenever a Phase I operation occurs, the tables which are generated as output are called New MIDAS Tables. Whenever the MIDAS Translator is run for strictly translation purposes or for augmenting existing MIDAS tables, an existing set of tables must be provided as input; these existing tables are called Old MIDAS Tables. Thus, every MIDAS Translator run except the initial run which builds the first set of tables for a particular project and/or target computer will require a set of Old MIDAS Tables.

The old and new tables are input and output as binary files. The file names are dependent upon the computer system on which MIDAS is running. In addition, there are three other files: card image input, printed output, and translated output.

The card image input file contains two optional blocks of information, of which at least one of the blocks must be present. The first block is the data structure definition using the language described in Section C. The other block contains the programs to be translated, written in MIDAS language. Each program to be translated must terminate with a normal FORTRAN END card, and as many programs as desired may sequentially appear in the input. If both data structure definitions and source programs appear, the data structure definitions must come first.

Listed output from the MIDAS Translator includes all input information and diagnostics in the event of error. If a source program contains a MIDAS detectable error, an error statement will be inserted into the translated output for that program which will produce a FORTRAN error when the program is compiled. Subsequent source programs will be translated correctly.

The translated output file contains card images of the translated source program in the FORTRAN dialect appropriate to the target computing system.

2. <u>CDC Operating Details</u>

The following file names are used by MIDAS:

INPUT	Input card images
OUTPUT	Listed output
OLDMT	Old MIDAS Tables
NEWMT	New MIDAS Tables
FTNOUT	Translated source programs

The program operates in a field length of 55000_8 words. MIDAS can be called by the single control card:

MIDAS.

If the input card images are on a file other than INPUT, say, file SOURCE, then the control card should read:

MIDAS,SOURCE.

The MIDAS Translator on CDC systems provides complete translation capability to CDC, IBM, UNIVAC, and MULTICS target systems.

3. MULTICS Operating Details

The following file names are used by MIDAS:

FILEØ4	Input card images
FILEØ6	Listed output
FILEØ7	Translated source programs
FILEØ8	Old MIDAS Tables
FILEØ9	New MIDAS Tables

The MIDAS Translator on MULTICS provides complete translation capability to IBM, UNIVAC, and MULTICS target systems. Data structure definitions involving bit packed words are not permitted for translation to CDC target systems.

4. <u>IBM Operating Details</u>

The IBM version of MIDAS is under development at the present time.

5. <u>UNIVAC Operating Details</u>

The UNIVAC version of MIDAS is under development at the present time.

MEMORANDUM BDM/W-AFM-2390-78

11 May 1978

TO: MIDAS Users

FROM: A. F. Malmberg, Chief Scientist (5200)

SUBJECT: Multiple Definition Capability in MIDAS

MIDAS has been extended to permit the user to make multiple definitions of data structures and data structure members. These definitions may be made at the data structure, word, or byte level. This feature is supported by UPDATE level AM78131A and above of MIDAS.

The + symbol is used to separate the multiple definitions at a particular level. For example, two definitions of the data structure S can be made as follows:

S(AAA) = (J, K) + (L, M, N)

Note that each definition of the data structure may have a different number of words.

Multiple definitions at the word level can be accomplished as shown in this example:

S(AAA) = (J + P, K + B + C)

Multiple definitions at the byte level may also be made:

S(AAA) = (J, (D(3) + E, F(10), G(30) + H + W))

When making multiple definitions for a particular byte, the first definition listed must specify the byte size in bits; subsequent definitions of that byte must not specify the byte size.

Each data structure definition statement must contain unique names. Thus, the following multiple definition is not allowed:

S(AAA) = (J, K) + (L, J)

Other than common byte size for a particular byte, there are no restrictions imposed on the nature of the members in multiple definition. Thus, each member may be independently assigned pointer attributes and alternate FORTRAN array names. For example:

```
S(AAA) = (J)+(K,(F=*B(3)+C,D(5))+M=*S(R))
```

Data structure definition statements may be continued from one card image to the next if the last non-blank character on the card to be continued is either , or +.

AFM/mlh

APPENDIX C

THE PROGRAM DESIGN LANGUAGE

A. INTRODUCTION

The algorithms and program segments for MADEM have been developed using a program design language (PDL). The use of PDL permits design to be expressed without the necessity of using an implementation in a standard programming language to specify the design detail.

Traditionally, narrative descriptions, decision tables, and flowcharts have been used to describe the design of a software system. These techniques are now being challenged by program design languages such as that used for the MADEM design. These PDLs provide: (1) a vehicle to translate functional modeling concepts into program design; (2) a replacement for design logic flowcharts; and (3) a means for communication between technical and nontechnical personnel, designers and developers.

PDL also has the advantage of having a closer relationship to programming languages than traditional methods of expressing design, thereby permitting a more direct mapping of design specification into code.

PDL is English-like in its means of expression and follows certain semantic and syntactic conventions. The concepts of structured programming are applied in the form of basic control structures for logic flow and indentation. Top down programming is implemented by specifying in PDL the top level portion of the program and evolving the PDL into succeeding levels of detail. There is considerable latitude in the selection of predicate and function descriptions which may be in English, in a computer language, or some combination of both.

The PDL is used for both the actual design framework of the program as well as for algorithms appearing only in hard copy form. The use of PDL eliminates the need for all flow charts and provides a self-documenting capability for the program itself. Realization of an implementation consists

simply of adding the necessary coding to the logical design statements. Thus, the design language and the implementation language coexist in the final source code.

B. CONTROL STRUCTURES

Four types of control structures are used: sequential composition, DO WHILE, IF-THEN-ELSE, and CASE. By suitable combination of these four types, programs and algorithms of any complexity may be expressed. These basic structures are combined with an indentation notation which is used to delineate the bounds of each structure in the program or algorithm.

The keywords, DO WHILE, IF-THEN-ELSE, CASE, etc., are written as structured comments. This permits the predicates for DO WHILE, IF-THEN, and CASE to be written in more natural terms since they do not have to be intelligible to the compiler. In implementation they are followed immediately by the associated programming language code statements. Thus, the programmer has the ability to write programs in true structured style using language elements of his own choosing, along with the implementation of the structure using a standard programming language. In this way, the coding and design documentation are carried along in one-to-one correspondence.

In the structured comment format, each comment is begun with an asterisk to visually delineate comment lines from coding lines. A comment may be continued on the next line. However, the continuation line does not have the asterisk header and starts one column farther to the right than the initial line of comment. Thus, if, for a given indentation level, the comment asterisk appears in column n, the first character of the comment continuation will start in column n+1. All implementation statements also start in column n+1; if an implementation statement is continued, all such continuation lines start at column n+2. Thus, the structured skeleton of the program design in PDL is easily followed by the identifying asterisks which introduce the structured comments. Each subsequent indentation level is started three columns farther to the right from the previous level to indicate nested structures.

Sequential compositions are shown diagrammatically in Figure C-1 and are written on the same indentation level, as in this example:

```
*INITIALIZE CONTROL VARIABLES
*READ INPUT DATA
*BUILD DATA STRUCTURE
*TRAVERSE DATA STRUCTURE, GENERATING OUTPUT
```

The IF-THEN-ELSE structure shown in Figure C-2 is illustrated by:

```
*IF(predicate)THEN
     *BLOCK 1
*ELSE
     *BLOCK 2
*BLOCK 3
```

If the predicate is satisfied, then BLOCK 1 is executed. BLOCK 1 is automatically terminated by the appearance of ELSE on the same level as the IF-THEN. Thus, following completion of BLOCK 1, control is passed to BLOCK 3 (which is actually a sequential block following the IF-THEN-ELSE block, appearing here only for purposes of illustration). If the predicate is not satisfied, then BLOCK 2 is executed, followed by BLOCK 3.

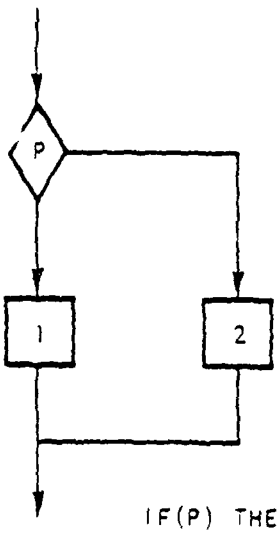
An alternate form of the IF-THEN-ELSE structure is shown in Figure C-3 and occurs when there is no ELSE part:

```
*IF(predicate)THEN
     *BLOCK 1
*BLOCK 3
```

If the predicate is satisfied, then BLOCK 1 is executed, followed by BLOCK 3. If the predicate is not satisfied, BLOCK 1 is not executed, and control passes immediately to the execution of BLOCK 3.

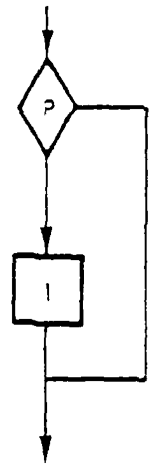

```
BLOCK 1
BLOCK 2
   •
   •
   •
```

Figure C-1. Sequential Composition



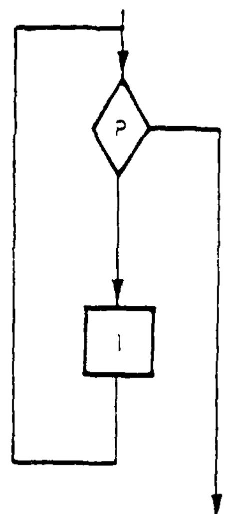

```
IF(P) THEN
    BLOCK 1
ELSE
    BLOCK 2
•
•
•
```

Figure C-2. If-Then-Else Structure




```
IF(P) THEN
    BLOCK 1
.
.
.
```

Figure C-3. If-Then Structure




```
DO WHILE(P)
    BLOCK 1
.
.
.
```

Figure C-4. Do While Structure

The DO WHILE structure is shown in Figure C-4 and has the form:

```
*DO WHILE(predicate)
     *BLOCK 1
*ENDDO
*BLOCK 2
```

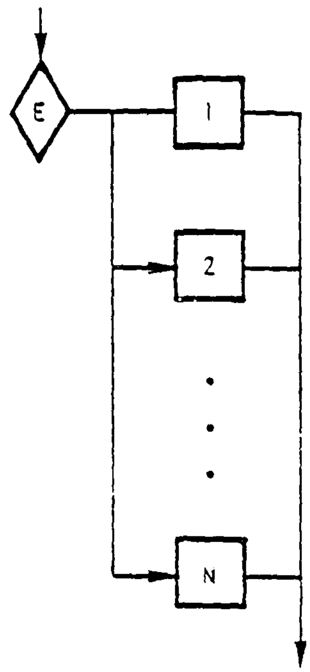
BLOCK 1 is executed until the predicate becomes FALSE. The use of the ENDDO statement is optional.

A variant on the DO WHILE is the DO, sometimes a more natural means of expressing the conditions for executing the subordinate block. Its action is identical to the DO WHILE:

```
*DO(predicate)
     *BLOCK 1
*BLOCK 2
```

Another type of control structure is the CASE structure shown in Figure C-5. This is used to select one of several possible blocks, depending upon the value of an expression. Its structure can be seen by the following example:

```
*CASE(expression)
     *Expression value = 1
          *BLOCK 1
     *Expression value = 2
          *BLOCK 2
     .
     .
     .
     *Expression value = n
          *BLOCK n
*BLOCK A
```




```
CASE(E)
  E = 1
    BLOCK 1
  E = 2
    BLOCK 2
  .
  .
  .
  E = n
    BLOCK N
.
.
.
```

Figure C-5. Case Structure

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MODULAR AIR DEFENSE EFFECTIVENESS MODEL, PROGRAM DOCUMENTATION --ETC(U)

JAN 80 M FILTEAU, B MACALEER, J T HAWKINS DNA001-79-C-0230

UNCLASSIFIED BDM/W-79-646-TR-VOL-2 DNA-5594F-2 NL

4 of 6

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The expression is evaluated and control is passed to a particular block, depending upon the expression value. Following completion of the specified block, control is passed out of the CASE structure to the next sequential block, BLOCK A.

C. SEGMENTATION

Programs are subdivided into segments, both for purposes of multiple references and to aid intellectual manageability. Each segment is labeled with a name to identify it. The name may be any English phrase of one or more words which serve to identify the segment, usually chosen to describe its function. The segment identification occurs as the first structure comment, using the keyword SEGMENT for identification:

```
*SEGMENT(GENERATE OUTPUT DISPLAY)
```

The segment identification may then be followed with arbitrary comments which provide further information on the purpose of the segment and its data and control interface, as needed. These explanatory comments do not use the asterisk header so that there will be no accidental confusion with the actual control structures which follow.

Segments may be referenced by using the keyword INCLUDE as in this example:

```
*INCLUDE(GENERATE OUTPUT DISPLAY)
```

The close of a segment is always indicated by the statement:

```
END
```

D. PROGRAM DESIGN AND IMPLEMENTATION

The program design process involves a complete logical specification of the program in PDL. All logical steps are expressed in the language

so that another person can fully comprehend the logical process being specified.

Combining these ideas permits the writing of algorithms and programs of any complexity. As an example, consider the following segment which specifies an algorithm for traversing an n-ary tree, where each node of the tree is represented by a linked list of sibling cells, each of which has a pointer to a descendant node. Thus, each sibling cell has two pointers, one for the sibling cell and one for the descendant node.

```
*SEGMENT(TRAVERSE N-ARY TREE)
*ENTER ROOT NODE
*TRAVERSE=TRUE
*BACKUP=FALSE
*DO WHILE(TRAVERSE)
     *IF(NODE CELL HAS DESCENDANT AND BACKUP=FALSE)THEN
          *DESCEND TO DESCENDANT CELL
     *ELSE
          *BACKUP TO PARENT CELL
          *IF(ROOT NODE)THEN
               *TRAVERSE=FALSE
          *BACKUP=TRUE
END
```

When the PDL structure is implemented, the programming language statements are inserted immediately following the corresponding PDL statement. In many cases, the implementation of a simple PDL structure will contain additional microstructure. Such microstructure should also follow the same rules for indentation of its logical elements.

As an example of the implementation of PDL into FORTRAN, consider the implementation of the above example for traversal of n-ary trees. The tree cells are stored in a FORTRAN array IQ with a pointer LTREE for the root cell of the tree. Each cell contains two pointers, with the first

cell word containing the sibling pointer and the second cell word containing the descendant pointer. A pointer value of zero indicates a null pointer which terminates the pointer chain. The implemented segment can thus be written as:

```
C         *SEGMENT(TRAVERSE N-ARY TREE)
           SUBROUTINE TRAVERSE(LTREE)
C          A PUSHDOWN STACK ISTACK WITH POINTER J IS USED TO BACKTRACK
C          TOWARDS ROOT NODE OF TREE
           COMMON/TREE/IQ(1000)
           DIMENSION ISTACK(100)
C         *ENTER ROOT NODE
           L=LTREE
           J=1
C         *TRAVERSE=TRUE
           ITRAV=1
C         *BACKUP=FALSE
           IBACK=0
C         *DO WHILE(TRAVERSE)
1000       IF(ITRAV.EQ.0) GO TO 2000
C              *IF(NODE CELL HAS DESCENDANT AND BACKUP=FALSE)THEN
                IF(IQ(L+1).EQ.0.OR.IBACK.NE.0) GO TO 1100
C                   *DESCEND TO DESCENDANT CELL
                     ISTACK(J)=L
                     J=J+1
                     L=IQ(L+1)
                     GO TO 1500
C              *ELSE
C                   *IF(NODE CELL HAS SIBLING CELL)THEN
1100                 IF(IQ(L).EQ.0) GO TO 1200
C                        *MOVE TO SIBLING CELL
                          L=IQ(L)
C                        *BACKUP=FALSE
                          IBACK=0
                          GO TO 1500
C                   *ELSE
C                        *BACKUP TO PARENT CELL
1200                      J=J-1
                          L=ISTACK(J)
C                        *IF(ROOT NODE)THEN
                          IF(L.NE.LTREE) GO TO 1300
C                             *TRAVERSE=FALSE
                               ITRAV=0
C                             *BACKUP=TRUE
1300                           IBACK=1
1500                GO TO 1000
2000      RETURN
          END
```

APPENDIX D

MIDAS TABLES

```
/MIDAS CDC
/DEFINE
ABINFO(ISPACE)=((NEXT=*ABINFO(30),NRACTYP(30)),
                (NOACOH(30),PTRACDB=*ACDB(30)),
                NORMRQ,
                NOREARMQ,.
                NOREFUELQ,
                NOLAUNCHQ,
                NOUSE)
ABQUEDB(ISPACE)=((PNEXT=*ABQUEDB(30),CLASS(30)),
                VALUE1(SPACE),
                VALUE2(SPACE),
                VALUE3(SPACE))
ABSTATUS(ISPACE)=((PACTAB=*ABINFO(30),NOACTAB(30)),
                (PTR2QUES=*QUEUES(30),NOACONAB(30)),
                ABDAMAGE(SPACE))
ABVCR(ISPACE)=((PNEXT=*ABVCR(30),PTRABSB=*SB(30)),
                (PACTAB=*ACTAB(30),NOACTAB(30)))
ACDB(ISPACE)=((NEXT=*ACDB(30),NRACTYPE(30)),
                MAXSPEED(SPACE),
                CRUISESPEED(SPACE),
                MAXALTITUDE(SPACE),
                MINALTITUDE(SPACE),
                MAXCLIMBDIVE(SPACE),
                FUELCONSUME(SPACE),
                ACQRANGE(SPACE),
                RADARCS(SPACE),
                ATTACKRADIUS(SPACE),
                MAXFUEL(SPACE))
ACQBUF(ISPACE)=((PTRACQ=*ACQDEVICE(30),NUMDEV(30)))
ACQDEVICE(ISPACE)=((PNEXT=*ACQDEVICE(30),TYPE(30)),
                (WORKING(30),PACQDB=*AQDB(30)),
                (JAM(30),LEVEL(30)))
ACRFTLIST(ISPACE)=((PNEXT=*ACRFTLIST(30),ACRFTID(30)),
                NUMACRFT,
                FORMTYPE)
ACRFTONAB(ISPACE)=((PNEXT=*ACRFTONAB(30),ABID(30)),
                (ACRFTLIST(30),NUMBLOKS(30)))
ACTAB(ISPACE)=((PNEXT=*ACTAB(30),NRACTYP(30)),
                (NOACOH(30),NOACASN(30)))
ADDLINK(ISPACE)=((NEXT=*ADDLINK(30),ID(30)))
ADSITEDB(ISPACE)=((PNEXT=*ADSITEDB(30),ADTYPE(30)),
                (MODVAL1(30)+INSTANT,MAXDIGEST(30)),
                (MAXCYCLEDIGEST(30).MINTIMEDIGEST(30)),
                LOSTTIME(SPACE),
                LASTCHANCE(SPACE)+LOWRESPTIME(SPACE),
                ENGAGEWINDOW(SPACE),
                MODVAL2(SPACE),
                MODVAL3(SPACE),
                (COVONONE(30),ONE(30)),
                (COVONFEW(30),FEW(30)),
```

```
                    (COVONMANY(30),MANY(30)).
                    TIMEFLIGHT(SPACE),
                    MISSILERANGE(SPACE),
                    (MAXASSIGN(30),MODVAL4(30)+DILSIZE).
                    MODVAL5(SPACE)+TSEEKTAC(SPACE),
                    MAXTRACKRANGE(SPACE)+TCHKCOV(SPACE).
                    LOCKONTIME(SPACE)+TSEEKENG(SPACE),
                    MODVAL6(SPACE)+HILIM(SPACE),
                    MODVAL7(SPACE)+LOWLIM(SPACE).
                    CONVLOAD,
                    (SNUKELOAD(30),LNUKELOAD(30)),
                    (CVRESUPPLYFREQ(30),RESUPPLYCV(30)).
                    (SNRESUPPLYFREQ(30),RESUPPLYSN(30)),
                    (LNRESUPPLYFREQ(30),RESUPPLYLN(30)))
ALLOCATE(ISPACE)=((PUP=*ALLOCATE(30),PDOWN=*ALLOCATE(30)),
                    (AMMOTYPE(30),PFU=*FIREUNIT(30)))
ANYDIL(ISPACE)=((PUP=*ANYDIL(30),PDOWN=*ANYDIL(30)),
                    (PPERC=*PERLIST(30),PDIB=*DIB(30)),
                    (LOC(30),PRIORITY(30)),
                    (PRIUP=*ANYDIL(30),PRIDN=*ANYDIL(30)).
                    (DCOV(30),SHORT(30)),
                    (PDELAY=*DAQE(30),PENGEV=*EVENT(30)).
                    (PAL(30),NULL(30)))
AQDB(ISPACE)=((NEXT=*AQDB(30),NRAQTYP(30)).
                    RANGE(SPACE),
                    NOUSE1,
                    NOUSE2)
ARCFTSAW(ISPACE)=((PNEXT=*ARCFTSAW(30),PSB=*SB(30)).
                    (ADDRESS=*HEX(30),TYPE(30)),
                    DAMAGE(SPACE))
ARCFTSTATUS(ISPACE)=((PFLTDB=*FLTDB(30),PMUNITIONS=*MUN(30)),
                    (PSTRTHX=*HEX(30),PENDHX=*HEX(30)),
                    (PNXTHX=*HEX(30),PAIRBASE=*SB(30)),
                    (NULL1(30).PAIRTGT=*SB(30)).
                    (PCNDTGT=*SB(30),NUMAIRCRAFT(30)),
                    (FLITELEG(4),INTERCEPTSTATUS(4),ALTUDECHNG(4).
                     PROFILENDX(4),LANDNG(4),ORBITSTAT(4),AIRCOMBAT(4),
                     NULL2(4),JAMSTAT(4),DUMMY(24)).
                    FUEL,
                    ALTITUDE(SPACE),
                    SPEED(SPACE),
                    DIRECTION(SPACE))
ATTACKBLOK(ISPACE)=((PNEXT=*ATTACKBLOK(30),PNXTGTL=*STDBLOK(30)),
                    (PFMAKTG=*FAKTGBLOK(30),NOFMAKT(30)).
                    (ISECTOR(30),PNXTCRD=*CORRIDORBLOK(30)))
BLOKHEAD(ISPACE)=((STATUS(24),TIMEGOT(17),ALLOCATOR(10),TYPE(9)))
BOCDIL(ISPACE)=((PUP=*BOCDIL(30),PDOWN=*BOCDIL(30)),
                    (PPERC=*PERLIST(30),PDIB=*DIB(30)),
                    (LOC(30),PRIORITY(30)),
                    (PRIUP=*BOCDIL(30),PRIDN=*BOCDIL(30)).
                    (DCOV(30),SHORT(30)),
                    (PDELAY=*DAQE(30),PENGEV=*EVENT(30)),
                    (PPAL=*PAL(30),PSUB=*SUBLIST(30)))
BOCNOCHANCMSG(ISPACE)=(NULL1,
                               NULL2,
..
```

```
                       NULL3,
                       (NULL4(30),PTGTSB=*SB(30)))
BOCSTAT(ISPACE)=((AUTO(30),READY(30)),
                 (PSDIG=*EVENT(30),PSDELY=*EVENT(30)),
                 (PADIL=*BOCDIL(30),NADIL(30)),
                 (PHFOQ=*BOCDIL(30),PTFOQ=*BOCDIL(30)),
                 (PHNDIL=*PERLIST(30),PTNDIL=*PERLIST(30)),
                 (HPRIOR=*BOCDIL(30),TPRIOR=*BOCDIL(30)),
                 (PPDIL=*BOCDIL(30),NUMRDY(30)),
                 (PHDAQ=*DAQE(30),PTDAQ=*DAQE(30)))
BOCTGTLOSTMSG(ISPACE)=(NULL1,
                       NULL2,
                       NULL3,
                       (NULL4(30),PTGTSB=*SB(30)))
SORBSTAT(ISPACE)=((AUTO(30),READY(30)),
                   (PSDIG=*EVENT(30),PSDELY=*EVENT(30)),
                   (PADIL=*ANYDIL(30),NADIL(30)),
                   (PHFOQ=*ANYDIL(30),PTFOQ=*ANYDIL(30)),
                   (PHNDIL=*ANYDIL(30),PTNDIL=*ANYDIL(30)),
                   (HPRIOR=*ANYDIL(30),TPRIOR=*ANYDIL(30)),
                   (ODIL=*ANYDIL(30),CAPACITY(30)),
                   (PHDAQ=*DAQE(30),PTDAQ=*DAQE(30)))
BTRYDIL(ISPACE)=((PUP=*BTRYDIL(30),PDOWN=*BTRYDIL(30)),
                 (PPERC=*PERLIST(30),PDIB=*DIB(30)),
                 (LOC(30),PRIORITY(30)),
                 (PRIUP=*BTRYDIL(30),PRIDN=*BTRYDIL(30)),
                 (DCOV(30),SHORT(30)),
                 (PDELAY=*DAQE(30),PENGEV=*EVENT(30)),
                 (PAL=*ALLOCATE(30),NUKE(30)),
                 (CEASE(30)+PDIBASSN=*DIB,ASSNPRIOR(30)),
                 (WAITTOTRACK(30),WAITTOFIRE(30)),
                 START(SPACE),
                 END(SPACE))
BTRYFIREMSG(ISPACE)=(NULL1,
                     NULL2,
                     NULL3,
                     (MISSILES(30),EMPTY(30)))
BTRYSTAT(ISPACE)=((AUTO(30),NUM(30)),
                  (PSDIG=*EVENT(30),PSDELY=*EVENT(30)),
                  (PADIL=*BTRYDIL(30),NADIL(30)),
                  (PHFOQ=*BTRYDIL(30),PTFOQ=*BTRYDIL(30)),
                  (PHNDIL=*PERLIST(30),PTNDIL=*PERLIST(30)),
                  (HPRIOR=*BTRYDIL(30),TPRIOR=*BTRYDIL(30)),
                  (TRACKED=*BTRYDIL(30),IDLE(30)),
                  (PHDAQ=*DAQE(30),PTDAQ=*DAQE(30)),
                  (PTL(30),A1(30)+CAMMO),
                  (RESUPPLY(30),A2(30)+N1AMMO+TOTAMMO),
                  (NUCNO(30),A3(30)+N2AMMO),
                  (AMTOT(30),NUMENG(30)))
BYCEASEMSG(ISPACE)=(NULL1,
                    NULL2,
                    NULL3,
                    (PTGTSB=*SB(30),NULL4(30)))
BYENGPROGMSG(ISPACE)=(NULL1,
                      NULL2,
..
```

```
                          NULL3.
                          (PTGTSB=*SB(30).NULL4(30)))
BYFLTATTMSG(ISPACE)=(NULL1,
                         NULL2,
                         NULL3,
                         (PTGTSB=*SB(30),NKILLED(30)),
                         TIME(SPACE))
BYNOCHANCMSG(ISPACE)=(NULL1.
                          NULL2.
                          NULL3,
                          (PTGTSB=*SB(30),NULL4(30)),
                          TIME(SPACE))
BYRELOADMSG(ISPACE)=(NULL1,
                         NULL2,
                         NULL3,
                         (ROUNDS(30),NRFP(30)))
BYTRKCHGMSG(ISPACE)=(NULL1,
                         NULL2,
                         NULL3,
                         (PTGTSB=*SB(30),NULL4(30)),
                         TIME(SPACE))
BUFFER(ISPACE)=((PSTART=*LINK(30),NUMLINK(30)))
C2(ISPACE)=(UNITNUMBER,
                    (PUP=*C2(30),PDOWN=*C2(30)),
                    (PSB=*SB(30),FNEXT=*C2(30)),
                    (UNITTYPE(30),SIDE(30)))
C2SIDE(ISPACE)=((PTRDOWN=*C2(30),SIDE(30)))
CHAINBLOKR(ISPACE)=((NULL(30),PNEXT=*CHAINBLOKR(30)))
COMMAND(ISPACE)=((PNEXT=*COMMAND(30),NUMACTS(30)),
                    (TMFLG(30),ADDRESS=*HEX(30)),
                    TIME(SPACE) + ACTION)
CONSTBLOK(ISPACE)=(CORDSLOPE(SPACE),
                    YINTLBUF(SPACE),
                    YINTLCOR(SPACE),
                    YINTRCOR(SPACE),
                    YINTRBUF(SPACE),
                    XSPREAD(SPACE),
                    YSPREAD(SPACE),
                    ENTRYSLOPE(SPACE),
                    YLINENTRY(SPACE),
                    YENDCORD(SPACE))
CORRIDORBLOK(ISPACE)=((PNEXT=*CORRIDORBLOK(30),NRCORD(30)),
                    (PABVSCOR=*ABVCR(30),NOABVCR(30)),
                    (PLHEX=*HEX(30),PRHEX=*HEX(30)),
                    (PCHEX=*HEX(30),NHWIDTH(30)),
                    (PHLIST=*HEXBLOK(30),PBDCNST=*CONSTBLOK(30)),
                    DEPTHCR(SPACE),
                    ANGCORD(SPACE),
                    ANGSPRD(SPACE),
                    BUFRWDH(SPACE))
COVERFU(ISPACE)=((PNEXT=*COVERFU(30),PAL=*ALLOCATE(30)),
                     (NULL(30),AMMO(30)))
CRCDEADBLOK(ISPACE)=((PSEERSB(30),NULL(30)),
                         (DEADUNITSB(30),UNITTYPE(30)))
CRCMSGDATA(ISPACE)=((MSGTYP(30),PSNDRSB(30)),
..
```

```
                     (PTGTSB(30)+PDEADSB+PMOVRSB+PLOSTSB+PINTSB,
                      TGTTYP(30)+DEADTYP+ADDRESS+NULL+NUMACFT))
CRCSEEBLUE(ISPACE)=((PNEXT=*CRCSEEBLUE(30),ID(30)),
                    (PSB=*SB(30),ADDRESS=*HEX(30)))
CRCSEERED(ISPACE)=((PNEXT=*CRCSEERED(30),ID(30)),
                    (PSB=*SB(30),ADDRESS=*HEX(30)),
                    (RPT(30),HUNTER(30)),
                    DIRECTION(SPACE),
                    (PNXTSER=*SEER(30),NUMSEE(30)))
CRCSEES(ISPACE)=((REDSEE=*CRCSEERED(30),NUMRED(30)),
                    (BLUESEE=*CRCSEEBLUE(30),NUMBLUE(30)))
CRCSUBORD(ISPACE)=((PNEXT=*CRCSUBORD(30),ID(30)),
                    (PSB=*SB(30),ADDRESS=*HEX(30)),
                    (ABSCRMBLFLG(30),BTNASNDCNT(30)+
                                     ACRFTASN2AB+
                                     NTRCPTRASNMNT+
                                     NUMACONAB))
DAQE(ISPACE)=(      (PPREV=*DAQE(30),PNEXT=*DAQE(30)),
                    (ACTID(30),PTR(30)),
                    (ARG1(30),PNDA=*DAQE(30)),
                    (ARG2(30),ARG3(30)))
DATBLOK(ISPACE)=((PNEXT=*DATBLOK(30),CLASS(30)),
                    (PADSITE=*ADSITEDB(30)+
                     PFORM=*FDBDBLOK+
                     PFLTDB=*FLTDB+
                     PACDB=*ACDB+
                     PPAYBUF=*PAYBUF+
                     PPROFIL=*PROFILEDBLOK+
                     PAQDB=*AQDB+
                     PABQUE=*ABQUEDB+
                     PACONAB=*ACRFTONAB+
                     PCLASS,NUMBLOK(30)))
DATBUF(ISPACE)=((PDATBLK=*DATBLOK(30),NUMBLOK(30)))
DBCLASSBLOK(ISPACE)=((PNEXT=*DBCLASSBLOK(30),CLASS(30)),
                    (PTR(30),NUMBER(30)))
DEATHBLOK(ISPACE)=((PSB=*SB(30),PADR=*HEX(30)),
                       (UNITTYPE(30),SIDE(30)))
DIB(ISPACE)  =      (TIME(SPACE),
                    (SIDE(30),NUMAC(30)),
                    (LOST(30),POSITION(30)),
                    HEADING(SPACE),
                    VELOCITY(SPACE),
                    ALTITUDE(SPACE))
DUMMYBLOCK(ISPACE)=((PNEXT(30),NEWKEY(30)))
ENGDATUPDMSG(ISPACE)=(NULL1,
                          NULL2,
                          NULL3,
                          (PTGTSB=*SB(30),COVER(30)),
                          STARTOPP(SPACE),
                          ENDOPP(SPACE),
                          (PDIB=*DIB(30),PRIORITY(30)))
ENGRESULT(ISPACE)=((NKILLED(30),PFU(30)))
EVENT(ISPACE)=((NEHMEN=*SB(30),INCDNT(30)),
                    (PTRUP=*EVENT(30),PTRDOWN=*EVENT(30)),
                    (MSG(30),LASSEN=*SB(30)),
..
```

```
                  TIME(SPACE))
FAKTGBLOK(ISPACE)=((PNEXT=*FAKTGBLOK(30),PNXFRDB=*FDBDBLOK(30)),
                  (PFLTAKT=*FLTAKTBLOK(30),NOFLAKT(30)))
FDBDBLOK(ISPACE)=((PNEXT=*FDBDBLOK(30),NRFORM(30)),
                  (PTRFLT=*FMFLTDB(30),NOFLTL(30)),
                  SPFORMC(SPACE))
FIREUNIT(ISPACE)=((AMMO(30),PNEXT=*FIREUNIT(30)),
                  (PDIL=*BTRYDIL(30),STAGE(30)),
                  (CEASE(30),PENGEV=*EVENT(30)),
                  (CAMMO(30),BUSY(30)),
                  (N1AMMO(30),N2AMMO(30)))
FLTAKTBLOK(ISPACE)=((PNEXT=*FLTAKTBLOK(30),PNXFLDB=*FLTDB(30)),
                  (NOACFLT(30),PFLABSB=*SB(30)),
                  (PNXACAB=*ACTAB(30),PTRFRAG=*COMMAND(30)),
                  PFLTSB=*SB)
FLTDB(ISPACE)=((PNXFLDB=*FLTDB(30),NRFLITE(30)),
                  (PTYPLDS=*PAYLOAD(30),NOPYLDS(30)),
                  (PTYACDB=*ACDB(30),PTACDB=*ACDB(30)),
                  (MAXNOAC(30),MINNOAC(30)),
                  (MULTAC(30),PROFILE=*PROFILEDBLOK(30)),
                  SPFLTC(SPACE),
                  DISTSEP(SPACE))
FLTDEADMSG(ISPACE)=(NULL1,
                       NULL2,
                       NULL3,
                       (PSB=*SB(30),PADR=*HEX(30)),
                       (UNITTYPE(30),SIDE(30)))
FMFLTDB(ISPACE)=((PNEXT=*FMFLTDB(30),PNXFLDB=*FLTDB(30)))
FOREST(ISPACE)=((PNEXT=*FOREST(30),NRTYPE(30)),
                  PTREE=*TGTPTREE)
FORMATION(ISPACE)=((PFORM=*WINGMAN(30),NUMFLTS(30)))
FORMATIONBLOK(ISPACE)=((PNEXT=*FORMATIONBLOK(30),PNXFRDB=*FDBDBLOK(30)),
                  (NOFRMRQ(30),NOFRMAL(30)))
FORTGTBUFFER(ISPACE)=((PFOREST=*FOREST(30)+
                  PTGT,VARWORD(30)))
GARBLOK(ISPACE)=((NULL(30),PNEXT=*GARBLOK(30)))
HEADBLOCK(ISPACE)=((PLIST(30),KOUNTER(30)))
HEX(ISPACE)=((HEXNUMBER(30),LEVEL(30)),
                  (PUP=*HEX(30),PDOWN=*HEX(30)),
                  (TERRAIN(30),PNEXT=*HEX(30)),
                  (PUOL=*BUFFER(30),PEEPER=*BUFFER(30)))
HEXBLOK(ISPACE)=(ITOTAL,
                  (PHEX4=*HEXLINK(30),NOLIST1(30)),
                  (PHEX1=*HEXLINK(30),NOLIST2(30)),
                  (PHEX3=*HEXLINK(30),NOLIST3(30)),
                  (PHEX6=*HEXLINK(30),NOLIST4(30)),
                  (PHEXUNK=*HEXLINK(30),NOLISTUNK(30)))
HEXELEV(ISPACE)=(ELEVAT(SPACE))
HEXLINK(ISPACE)=((PNEXT=*HEXLINK(30),HEX(30)))
LEFTREE(ISPACE)=(TIME(SPACE),
                  (PEVENT=*EVENT(22),DIST(4),PLEFT=*LEFTREE(17),
                  PRITE=*LEFTREE(17)))
LINK(ISPACE)=((PNEXT=*LINK(30),PSB=*SB(30)))
LISTENDPTRS(ISPACE)=((PHEAD(30),PTAIL(30)+NENT))
LOAD(ISPACE)=((PNEXT=*LOAD(30),TYPE(30)),
..
```

```
                (AMOUNT(30),PORDDB=*PAYLOAD(30)))
LOSTCOVER(ISPACE)=((PNEXT=*LOSTCOVER(30),PDIL=*BOCDIL(30)),
                   (NULL(30),PRIORITY(30)))
LOSTSIGHTBLOK(ISPACE)=((NULL(30),NOSEER(30)),
                       (ARCFT(30),ADDRESS(30)))
MESSAGE(ISPACE)=((PTR(30),FREQ(30)),
                 (VALUE1(30),VALUE2(30)) + (VALUE3(30)).
                 (TYPE(30),LENGTH(30)))
MISSILEFIRING(ISPACE)=((AMMOTYPE(30),PFU(30)),
                       TIMEINTERCEPT(SPACE))
MUN(ISPACE)=((PAG=*LOAD(30),NUMAG(30)),
                (PAA=*LOAD(30),NUMAA(30)))
NOAVAILBLOK(ISPACE)=(PNEXT=*NOAVAILBLOK.
                     PJDAMAGE(SPACE),
                     PSTDBLOK=*STDBLOK)
ORDERS(ISPACE)=((PTRFORMS=*FORMATION(30),PTRACT=*COMMAND(30)))
PAL(ISPACE)=(    (PUPT=*PAL(30),PDOWNT=*PAL(30)),
                 (PUPB=*PAL(30),PDOWNB=*PAL(30)),
                START(SPACE),
                END(SPACE),
                (COVER(30),PDIL=*BOCDIL(30)),
                (PEVENT=*EVENT(30),PSUB=*SUBLIST(30)))
PATENGAGE(ISPACE)=((PUP=*PATENGAGE(30),PDOWN=*PATENGAGE(30)),
                   (PDIL=*BTRYDIL(30),STAGE(30)),
                   (CEASE(30),PENGEV=*EVENT(30)))
PAYBUF(ISPACE)=((PNEXT=*PAYBUF(30),NRPDCLS(30)),
                (PAYLDDB=*PAYLDDBLOK(30),NUMBLOK(30)))
PAYLDDBLOK(ISPACE)=((NEXT=*PAYLDDBLOK(30),TYPEINDEX(30)))
PAYLOAD(ISPACE)=((PNXTYPD=*PAYLOAD(30),NRPDCLS(30)),
                (MAXAMT(30),MINAMT(30)),
                (MAXFIRERANGE(30),PAYLDDB=*PAYLDDBLOK(30)))
PERLIST(ISPACE)=((PUP=*PERLIST(30),PDOWN=*PERLIST(30)),
                (PSB=*SB(30),PDIL=*ANYDIL(30)),
                (SEEN(30),PSS=*SOURCE(30)),
                (PUPCHN=*PERLIST(30),PDNCHN=*PERLIST(30)),
                TIME(SPACE))
PLAYERBUFFER(ISPACE)=((PTRPL=*PLYLST(30),VARWORD(30)))
PLBUFFER(ISPACE)=((PTRPL=*C2(30),VARWORD(30)))
PLYLST(ISPACE)=((ILW(30),IRW=*PLBUFFER(30)))
POSSCOVER(ISPACE)=((PNEXT=*POSSCOVER(30),PDIL=*BOCDIL(30)+
                                        PBAT=*SUBLIST),
                   (PPAL=*PAL(30),PRIORITY(30)))
PROFILEDBLOK(ISPACE)=((PNXPRDB=*PROFILEDBLOK(30),NRPROFL(30)),
                ALTCREN(SPACE),
                ALTCMST(SPACE),
                ALTOAB(SPACE))
PUBUFFER(ISPACE)=((PSTART=*LINK(30),NUMLINK(30)))
QUESTAT(ISPACE)=(REALNUMBER(SPACE))
QUEUES(ISPACE)=((NEXT=*QUEUES(30),QUENUM(30)),
                (PTR(30),NUMBER(30)),
                (PQDB=*ABQUEDB(30),PQUESTAT(30)))
RAIDBLOK(ISPACE)=((PNEXT=*RAIDBLOK(30),NRRAID(30)),
                (PTRWAVE=*WAVEBLOK(30),NOWAVES(30)),
                (PTRCORD=*CORRIDORBLOK(30),NOCORDS(30)))
READYQUE(ISPACE)=((PNEXT=*READYQUE(30),NRACTYP(30)),
..
```

```
                    (NULL(30),NUMACRT(30)))
RELLIST(ISPACE)=((PNEXT=*RELLIST(30),PFU=*FIREUNIT(30)))
SAMASSIGNMSG(ISPACE)=(NULL1,
                              NULL2,
                              NULL3,
                              (PTGTSB=*SB(30),TGTID(30)+NCOV),
                              STARTOPP(SPACE),
                              ENDOPP(SPACE),
                              (PDIB=*DIB(30),TGTPRIOR(30)),
                              (EMPTY(30),DCOV(30)))
SB(ISPACE)=((ADDRESS=*HEX(30),PC2=*C2(30)),
                    (PSDB=*SDB(30),PFEL=*EVENT(30))+CUMLTIVDAMAGE,
                    (PACQ=*ACQBUF(30),ID(30)),
                    (DATABASE(30)+
                     ABFORMTYP,     PABSTATUS=*ABSTATUS(30)+


                                    PARCFTSTAT=*ARCFTSTATUS+
                                    PBOCSTAT=*BOCSTAT+
                                    PBTRYSTAT=*BTRYSTAT+
                                    REDARCFTUPCNT+
                                    STATUS))
SUB(ISPACE)=((PSB=*SB(30),PSEEBUF=*SEEBUF(30)+PSEE=*CRCSEES),
                    (SUBORDINATE=*SUB(30),ORD=*ORDERS(30)+
                    PRAID=*RAIDBLOK))
SEEBUF(ISPACE)=((PTRSEE=*ARCFTSAW(30),NUNITS(30)))
SEER(ISPACE)=((PNEXT=*SEER(30).PSEERSB(30)))
SOURCE(ISPACE)=((PSB=*SB(30),PNEXT=*SOURCE(30)))
STDBLOK(ISPACE)=((PNEXT=*STDBLOK(30),PTGTSB=*SB(30)),
                    PTGTLTR=*TGTPTREE,
                    DAMGPER(SPACE),
                    PADRPER=*HEX)
SUB(ISPACE)=((PSUB=*SUBTYPE(30),NUMBER(30)))
SUBLIST(ISPACE)=((PSB=*SB(30),PNEXT=*SUBLIST(30)),
                    (AUTO(30)+DEATHMARK,NUMFU(30)),
                    (RAMMO(30),LOAD(30)),
                    (PDELAY=*DACE(30),NOUSE(30)),
                    (PPAL=*PAL(30),ADDRESS=*HEX(30)))
SUBTYPE(ISPACE)=((PNEXT=*SUBTYPE(30),TYPE(30)),
                    (PTRSUB=*CRCSUBORD(30),NUMBER(30)))
TARGETBLOK(ISPACE)=((PNEXT=*TARGETBLOK(30),NRTGTYP(30)),
                    (PTRFORM=*FORMATIONBLOK(30),NOFORM(30)),
                    (PTGTATK=*ATTACKBLOK(30),NOTGTAK(30)),
                    (MAXACAL(30),NOACALC(30)),
                    (MAXRHEX(30),MINRHEX(30)))
TARGETBUFFER(ISPACE)=((PTR=*C2(30),VARWORD(30)))
TARGETLISTBLOK(ISPACE)=((PTRTYTL=*TTDBLOK(30),NOTYTPL(30)))
TGTPTREE(ISPACE)=(DAMAGE(SPACE),
                    (INVALID(1),PSTDBLOK=*STDBLOK(21),DIST(4),
                    PLEFT=*TGTPTREE(17),PRITE=*TGTPTREE(17)))
TRACKINGBLOK(ISPACE)=((NULL(30),PSEERSB(30)),
                         (PMOVRSB(30),ADDRESS(30)))
TTDBLOK(ISPACE)=((PNEXT=*TTDBLOK(30),NRTGTYP(30)),
                    (PTGTPL=*STDBLOK(30),NOTGTPL(30)))
UMPDAT(ISPACE)=((MISSILES(27),AMMOTYPE(3),ENGUNITTYPE(30)),
                    (PTGTSB=*SB(30),PFU(30)))
WAVEBLOK(ISPACE)=((PNEXT=*WAVEBLOK(30),NRWAVE(30)),
..
```

```
              (PTGTYPE=*TARGETBLOK(30),NOTGTYP(30)),
              STARTTIME(SPACE),
              DURATION(SPACE))
WINGMAN(ISPACE)=((PNEXT=*WINGMAN(30),PSB=*SB(30)))
/MACRO
$COMMONAAPK$
        COMMON/AAPK/AAPK(10)
$COMMONACFRAG$
        COMMON/ACFRAG/NSECTOR,PTGTHEX,PADRCG,PHEXENT,TATREND,PHEXEXT
$COMMONAFM$
        COMMON/AFM/JINX
$COMMONAGPD$
        COMMON/AGPD/AGPD(30)
$COMMONAGPK$
        COMMON/AGPK/AGPK(286)
$COMMONBLKTYP$
        COMMON/BLKTYP/KEBASE,NBLKTP,LNGBLK(500)
$COMMONCLOOK$
        COMMON/CLOOK/ISTABL,NRSRV,ISTAB(1)
$COMMONCOMOUT$
        COMMON/COMOUT/LBL(10,3),LBLCT
$COMMONCOMPTR$
        COMMON/COMPTR/
     +   PHXTOP,PTRBLUE,PTRRED,PBLTGT,PRDTGT,PTRC2,
     +   PBLUPL,PREDPL,PTRPL,PLASTC,PLASTS,LSIDE,LHEX,
     +   PTRCDB,PTRWDB,PTRRDB,PTRTTDB,BUFZN,
     +   IGMSRT,IDYSRT,PTRDATA,PTOPORD,PREDSEE,ISIZE
$COMMONCOMSCS$
        COMMON/COMSCS/LMASK,RMASK,INITCEL,TREETOP,ENDTIME,INCTIME,
     + GTIME,CELMARK,OUTIME,NVFEL,LMAX,CELMINT,LPTR(20)
$COMMONCRCCOM$
        COMMON/CRCCOM/IEVENT,PSB,PADR,ITYPE,ISIDE
$COMMONCSTK$
        COMMON/CSTK/IPSTK(300),L,LLMAX,NSTK
$COMMONDATA$
        COMMON/DATA/PTRDAT
$COMMONDEBUG$
        COMMON/CHECK/ICHKPTR(10),LASTVAL(10)
        COMMON/DEBUG/DBGA,DBGB,DBG,DBGD
        COMMON/DFLAGS/ IDEBUG,IDUMP,IDATFLG,ISTOP,IRECOVR,ITRACE,IRLSE
        COMMON/XTRACE/ ITRPTR,TRACIR(50),TRAPTR,TRAPDS(30),
     +                TIMEPDS(30),ICOUNT(320),PDSFLAG
        COMMON/STEXT/ SEGTXT(320),NOSEG,SEGFLAG(320),SEGTIME(320),
     +                DBGFLAG(320)
        COMMON/BLKDBG/IBLKHD,IBLKST,IBLKAL,IBLKRL,NBLKAL(500),
     +                NBLKRL(500)
        INTEGER SEGTXT,SEGFLAG,SEGNUM,DBGFLAG
        INTEGER TRACIR,TRAPTR,TRAPDS
$COMMONFS$
        COMMON/FS/PTRFS,PTRRSL,MXSPCE,ID,MXBLKR,LGARB(20)
$COMMONHALT$
        COMMON/HALT/IFSTOP,CPULIM,CELTIME,LEVEL(20),
     +              GTIMLIM,NOEVNTS,NOEVLIM
$COMMONINITPTR$
        COMMON/INITPTR/PTRADR,PPTRC2,PTRSDB,PTRFEL,PTRACO,PTRCOM,
..
```

```
     + PTRSTAT, PTRSEE, PTRSUB, PTRORD, MYTYPE, MYSIDE
$COMMONINTMSG$
      COMMON/INTMSG/MESSAGE, PTGTSB, ITYPE, PINTLST, PINTSB, PTGTBLK
$COMMONIODEV$
      COMMON/IODEV/IN, NUOIL, ND, IOUT, IHOLD(2), IFETCH(2), IBREAK, NOHOLDS
$COMMONJJOPT$
      COMMON/JJOPT/IOP
$COMMONLIMITS$
      COMMON/LIMITS/LOWER, LUPPER
$COMMONMASK$
      COMMON/MASK/IL, IR, ILM
$COMMONMODVAR$
      COMMON/MODVAR/INCDNT, NEHMEN, LASSEN, TIME, MSG, PTRGOD, RSEED
$COMMONMXMIS$
      COMMON/MXMIS/MXSUP(3, 3)
$COMMONORD$
      COMMON/ORD/TBAS, TCOM
$COMMONPATH$
      COMMON/PATH/LASTP, LREP, LASTR(15)
$COMMONPERCEEV$
      COMMON/PERCEEV/XSEER, YSEER, XSEEN, YSEEN, RANGE, BEARING, MASK
$COMMONSAMPK$
      COMMON/SAMPK/SAMPKA(3, 3), SAMPKB(3, 3)
$COMMONSAMPTRS$
      COMMON/SAMPTRS/PMYDATA, PDIL, PPPINFO, PDINFO, POINFO, PDAT,
     +                PPAL, PFU
$COMMONSECTOR$
      COMMON/SECTOR/PDAT, XD, YD, VX, VY, IFLAG, BEARING, VELOCTY, OHEAD,
     +               RELHEAD, CLINE, OFF, X, Y
$COMMONSEMINFO$
      COMMON/SEMINFO/IVALUE(20), VALUE(20), IFLAG
$COMMONSPACE$
      COMMON/SPACE/BLANK, ISPACE(1)
$COMMONSPACE100$
      COMMON/SPACE/BLANK, ISPACE(100000)
$COMMONSPACE50$
      COMMON/SPACE/BLANK, ISPACE(50000)
$COMMONSPSTAT$
      COMMON/SPSTAT/ICTGIM(20), ICTREL(20)
$COMMONSTATBD$
      COMMON/STATBD/PFLTTYP(1), PTRMUN, PTRSTRT, PTREND, PTRNXT, PTRAB,
     + NUMTGT, PTGTSB, PGNDTGT, NUMAC, LEGSTA, INTSTA, IALTCNG, NDXPROF,
     + LNDSTA, IORBSTA, IAIRCOM, IGNDATK, JAMSTA, FUEL, ALTUDE, SPEED, DIRECT
$COMMONTHTRPLN$
      COMMON/THTRPLN/PFOREST, PNOAVAL
$COMMONTRACK$
      COMMON/TRACK/PFADR, ISIDE
$COMMONTYPES$
      COMMON/TYPES/IARRAY(3000)
$DIMEQLEV$
      DIMENSION SPACE(1)
      EQUIVALENCE(ISPACE(1), SPACE(1))
      LEVEL 2,  ISPACE, SPACE, BLANK
$IMPLICIT$
      IMPLICIT  INTEGER(H, P), LOGICAL(Z)
..
```

```
$NOSEG$
 NOSEG = 320
/END
..
```

APPENDIX E
THE DYNAMIC EVENT SCHEDULING ALGORITHM

An event stepped simulation, such as TAC REPELLER, is controlled by one or more time sorted lists of event notices, where each event notice represents the occurrence of some event. At the start of the simulation, all the notices in the event lists correspond to exogenous events, i.e., events which are externally generated and act as a driving function for the simulation. As the simulation progresses, time is incremented as each event notice in the event lists becomes current. An event notice initiates a computational process which may generate additional event notices. In this way the simulation continues. The simulation stops whenever the event lists are exhausted or some other specified termination condition occurs.

The passage of time between events is generally very irregular. In fact, consecutive events may occur at the same instant of time, or there may be a very large time interval between them. Event stepped simulations are computationally efficient because of the ability of the event scheduling mechanism to initiate computation only at those times at which something is going on in the simulation.

The fundamental problem in an event stepped simulation is to devise an efficient way of locating the next event notice in time sequence. This can be done by keeping an event list in time sorted order so that the next event notice is always on the top of the list.

The algorithm for maintaining an event list must be chosen so that it is computationally efficient to 1) remove the event notice with the earliest time from the event list and 2) insert a new event notice into the list.

In TAC REPELLER the event notices for dynamically scheduled events are maintained in a quasi-sorted order using a bifurcated arborescence called a leftist tree (so called because it leans to the left, i.e., there are predominatly more links to the left than to the right). The algorithm for manipulating such a tree is such that the top cell of the tree (the root) is always guaranteed to be the cell with the earliest scheduled event time,

even though all other cells are only in quasi-sorted order. Despite some algorithmic complexity, the leftist tree software is very efficient.

Each event notice cell contains the scheduled event time, a path distance value, a pointer to a left subtree, and a pointer to a right subtree. The space requirements are $O(n)$, where n is the number of event notices in the event list.

Since the scheduled event time is the quantity upon which sorting is based, it will be referred to as the KEY in the following discussion. The path distance D is the minimum path length from the node to a leaf of the tree; because of the way in which the tree is constructed, this minimum length path will always be a rightmost path. The pointer to the left subtree will be denoted by LP, and the pointer to the right subtree will be denoted by RP. The pointer to a leaf in the tree will be assigned a value of 0. The lea does not actually contain any explicit information and therefore leaves are not actually represented in memory. We may refer to the KEY and D quantities for the cells comprising the roots of the left and right subtrees by KEY(LP), D(LP), KEY(RP), and D(RP). We adopt the convention that $KEY(0) = \infty$, and $D(0) = 0$.

The leftist tree may be defined by listing the properties of the KEY and D fields for each cell P:

(1) $KEY(P) \leq KEY(LP(P))$

(2) $KEY(P) \leq KEY(RP(P))$

(3) $D(P) = D(RP(P))+1$

(4) $D(LP(P)) \geq D(RP(P))$

These properties ensure that any path from the root to a leaf traverses the event notices in ascending time order. Thus, the root always contains the next scheduled event notice.

Removal of the root of the leftist tree (i.e., removal of the next scheduled event notice) requires a constant time. However, it must be followed by a merging of the two subtrees below the root before any other operations are executed on the tree. Merging of the subtrees (both of which are themselves leftist trees) is the most expensive operation. In the worst

case this requires m merge steps followed by m interchange steps, where

m = least integer not less than $\log^2(n)$

n = number of nodes (event notices) in the tree.

The subtree merging is not required if the right subtree is vacuous, and is trivial if the left subtree is vacuous. Thus, merging of leftist trees requires time of O(log n) in the worst case. Insertion of a new cell into the tree also requires O(log n) in the worst case. In the best case, merging and insertion require a constant time. Furthermore, the software for merging and insertion is identical so that only a single routine is required for all tree manipulations. The overhead for small n is reasonable and the method is very efficient for large n.

The algorithm for merging two leftist subtrees P and Q utilizes a stack for saving the nodes which are visited during the tree traversal. The algorithm is:

```
*IF(KEY(SUBTREE P) IS GREATER THAN KEY(SUBTREE Q)) THEN
     *INTERCHANGE SUBTREES P AND Q
*IF (SUBTREE P IS VACUOUS) THEN
     *SUBTREE P = SUBTREE Q
*ELSE
     *MERGE SUBTREE Q INTO SUBTREE P
          *SUBTREE X = P
          *DO WHILE(SUBTREE Q EXISTS)
               *QKEY = KEY(Q)
               *TRAVERSE SUBTREE X ALONG THE RIGHTMOST LINKS, COMPARING KEY
                AT EACH NODE OF X WITH QKEY, SO AS TO LOCATE THE INSERTION
                POINT FOR Q ACCORDING TO ASCENDING KEY VALUE.  SAVE THE
                NODES OF X WHICH WERE TRAVERESED ON THE STACK.
               *BREAK SUBTREE X AT THE INSERTION POINT, SAVING THE SUBTREE
                OF X BELOW THE INSERTION POINT AS SUBTREE T.
               *APPEND SUBTREE Q TO SUBTREE X AT THE INSERTION POINT, USING
                THE LEFT LINK IF IT IS NOT ALREADY IN USE: OTHERWISE USE THE
                RIGHT LINK.
               *SUBTREE X = Q
               *SUBTREE Q = T
          *DO(FOR ALL NODES SAVED ON STACK DURING TRAVERSE, STARTING AT LAST
           INSERTION POINT AND ENDING AT THE ROOT)
               *IF(DISTANCE TO LEAF FROM LEFT SUBTREE SHORTER THAN FOR RIGHT
                SUBTREE) THEN
                    *INTERCHANGE SUBTREES
               *CALCULATE DISTANCE FOR PARENT NODE OF SUBTREES
```

An example of event sorting using the leftist tree algorithm will now be given. We start with the leftist tree shown in Figure E-1(a). The event notices are numbered with the integers, where the integer value is the scheduled time for the event notice.

The next scheduled event 1 is removed. This splits the original tree into two subtrees as shown in Figure E-1(b). We must merge subtree 3 into subtree 2. This is doen by traversing subtree 2 along the rightmost path, until an insertion point is found for subtree 3. This insertion point will be between nodes 2 and 5. A subtree with root 5 is detached and the subtree 3 is appended to subtree 2 at the insertion point. This produces the configuration shown in Figure E-1(c).

Now subtree 5 must be merged into subtree 2. Subtree 2 is traversed along the rightmost path until an insertion point for subtree 5 is found. This insertion point will be between nodes 3 and 8 in Figure E-1(c). A subtree with root node 8 is detached and subtree 5 is appended to subtree 2 at the insertion point. This produces the configuration shown in Figure E-1(d).

Next subtree 8 must be merged into subtree 2. Subtree 2 is traversed along the righmost path until an insertion point for subtree 8 is found. This insertion point is after node 5 in Figure E-1(d). Since no right subtree exists below node 5 at this time, no subtree can be detached, and subtree 8 is simply appended as the right subtree for node 5. This produces the configuration shown in Figure E-1(e).

Subtree merging has now been completed. Now the nodes traversed during the merging process must be traversed in reverse order and subtree interchanges made as necessary to produce a leftist tree (note that the tree in Figure E-1(e) is a rightist tree). The subtree with root node 5 is already in leftist form so no action is required.

The subtree with root node 3 is not a leftist tree, therefore interchange the left and right subtrees below node 3. This produces the leftist subtree with root node 3 shown in Figure E-1(f).

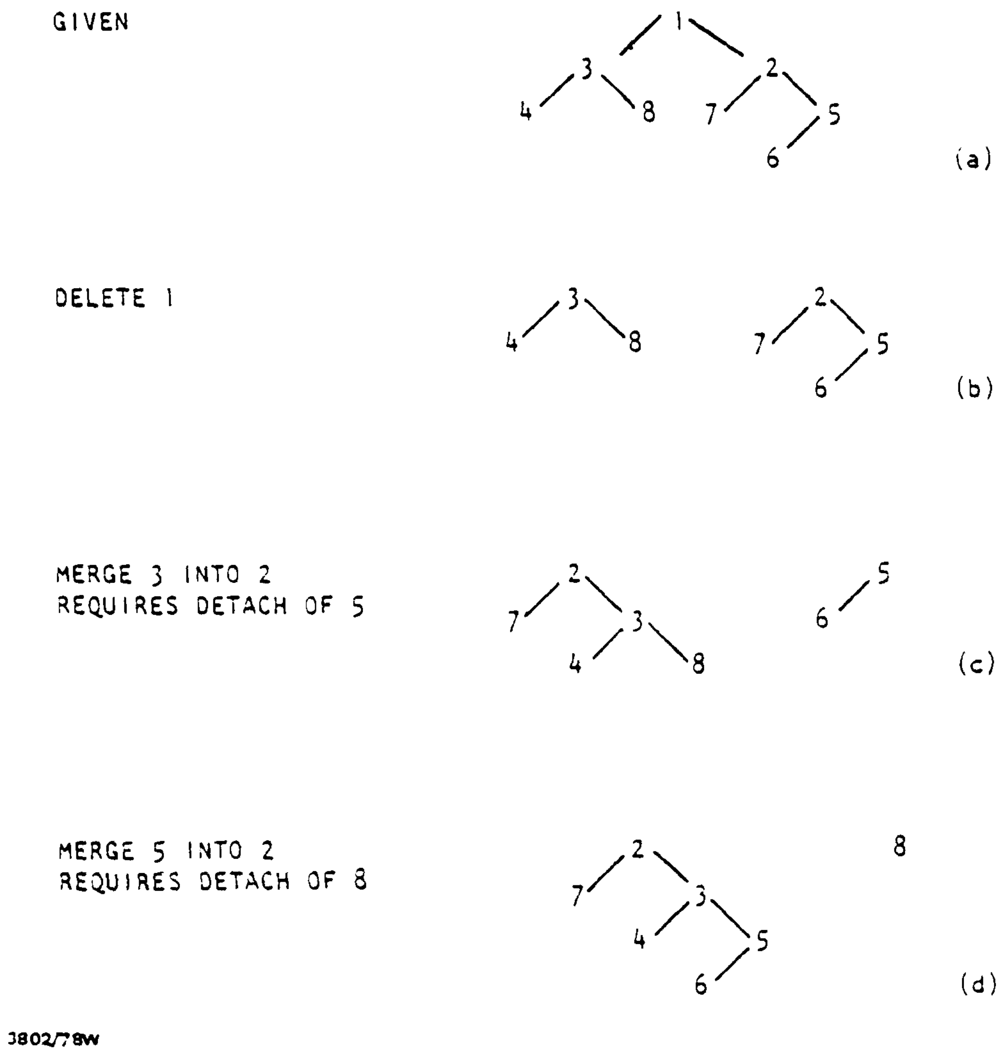
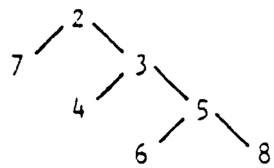


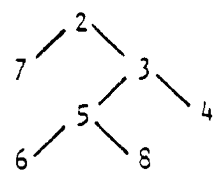
Figure E-1. Example of Merging of Leftist Trees

MERGE 8 INTO 2



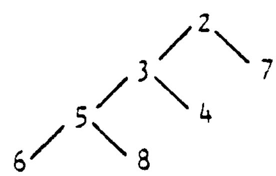
(e)

INTERCHANGE 4 AND 5



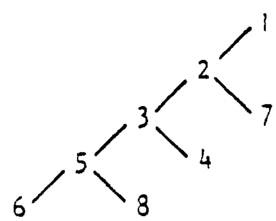
(f)

INTERCHANGE 7 AND 3



(g)

ADD 1



(h)

3802/78W

Figure E-1. Example of Merging of Leftist Trees (Continued)

The subtree with root node 2 is not a leftist tree, therefore interchange the left and right subtrees below node 2. This produces the leftist subtree with root node 2 shown in Figure E-1(g). Since node 2 is the root of the entire tree, the entire tree is now in leftist form. This completes the merging process.

Now let us add node 1 back into the tree of Figure E-1(g). Since node 1 corresponds to an earlier time than any node of the leftist tree into which it is being merged, we see that node 1 becomes the root node of a new tree. This new leftist tree is shown in Figure E-1(h). Note that its form is radically different from the original tree in Figure E-1(a).

This example represents the worst case situation for merging two subtrees.

APPENDIX F

MADEM EVENT CODE DEFINITIONS

EVENT CODE	MESSAGE CODE	SCHEDULING SUBROUTINE	EVENT
12691111		BADMOVE	Schedule CRC Assignment
12691111		CRCLOSS	Schedule Assignment
12691111		CRCKIL	CRC Assignment
12691111		INT2CRC	Schedule CRC Assignment
12691111		NEWMOVE	Schedule CRC Assignment
14651250		GNDLOOK	Target found, Schedule Attack
25120001	1312	INTASIN	Request interceptor launch
25120001	1510	INTASIN	Message to interceptor of assignment
25120001	2731	BTNASIN	Message BTN assignment
25340001	2751	AMMOCHK	Schedule common BTN (Firing Support)
25390001	1310	INTRFLY	Request orders from CRC
25390001	1340	FUELCHK	Schedule commo CRC, Return to Airbase
25390001	1984	COMMAND	Message to tower to land
25390001	1984	INTRFLY	Request landing from Airbase
25620001	1330	INTFIND	Message to CRC reporting direction
25650001	1300	FLYSEE	Schedule interceptor available, target dead message
2565001	1312	CRCTRAK	Send scramble message
25650001	1320	AIRTHNK	Schedule msg. to live CRC of availibility
25650001	1330	CRC2INT	Schedule msg. to CRC can't accept assignment
25690001	2	BNCMDPR	commo CRC not ready
25690001	2	BNNOTRD	Schedule commo CRC not ready

MADEM EVENT CODE DEFINITIONS

EVENT CODE	MESSAGE CODE	SCHEDULING SUBROUTINE	EVENT
25690001	3	BNPONBB	Schedule commo CRC, ready
25690001	1310	CRC2INT	Schedule interceptor available message to CRC
25690001	1320	AIRTHNK	Schedule msg to CRC of new target
25690001	1340	DOGTHNK	Message to CRC of unavailability
25690001	1500	BADMOVE	Schedule break off message to interceptor
25690001	1520	BADMOVE	Schedule msg to interceptor of new vector
25690001	1520	INT2CRC	Schedule message to interceptor to fly towards CRC (Return to)
25690001	1600	BNCONLS	Schedule commo CRC target lost
25690001	1600	BNCMDPR	Commo CRC loss of sight of target
25690001	1600	BOCTINK	Schedule commo CRC target unseen
25690001	1620	BNCONTC	Schedule commo CRC consider track change
25690001	2752	BYPONRL	Schedule commo BTN reload
25690001	2761	BYHEDUP	Schedule commo BTN no chance
25690001	2761	BNLALLE	Schedule commo superior, no chance
25690001	2762	BYCONLS	Track loss for BTN
25690001	2762	BYNWTRK	Schedule commo BTN track change
25690001	2762	BYCONTC	Schedule commo BTN track change
25690001	2762	BTRYTNK	Schedule commo BTN target not sighted
25690001	2780	BYPONER	Schedule engagement results for BTN
25690001	2790	BYPONFD	Schedule commo BTN flight dead
25690001	2831	ALLOBAT	Btry engage command

MADEM EVENT CODE DEFINITIONS

EVENT CODE	MESSAGE CODE	SCHEDULING SUBROUTINE	EVENT
25690001	2832	BNPONEP	Schedule commo Btry cease fire
25690001	2832	DECRALO	Cease fire msg for battery
25690001	2832	DROPPOS	Schedule commo btry ceasefire
25690001	2832	DROPPS2	Schedule commo btry ceasefire
25690001	2834	ALLOBAT	Btry coverage update
25690001	2834	DECRALO	Coverage update message
25690001	2835	BNCONHD	Schedule commo Btry engagement data update
25930001	1700	GOGETEM	Call CRC to notify of takeoff
31691000		AIRTHNK	Schedule dogfite
34342950		ENGAGE	Schedule engage Btry fire
34342951		ENGAGE	Schedule engage Btry fire
34692900		ALLOPAT	Schedule engage Btry (Lockon)
34692900		ALLOFU	Schedule engage Btry (Lockon)
34692900		BYTKCHK	Schedule engage Btry (Lockon)
34692901		BYPONER	Schedule engage to fire again
34692901		PTPONER	Schedule engage to fire again
34692950		BYPONTM	Schedule engage Btry fire
39391313		FLITE	Schedule next fly
39931313		GOGETEM	Schedule launch of interceptor
39931313		TOWER	Schedule fly flight take off
62141100		ATKASES	Schedule death perception
62311100		DOGFITE	Schedule death perception
62391100		SHRKILL	Schedule ptrgod to perceive death
62391313		FLITE	Schedule Naybor flying plane
62391380		COMMAND	Schedule Naybor ECM on
62391390		COMMAND	Schedule Naybor ECM OFF

MADEM EVENT CODE DEFINITIONS

EVENT CODE	SCHEDULING SUBROUTINE	EVENT
62931100	TOWER	Schedule naybor others notice landing
62951100	UMPIRE	Schedule naybor flight death
65141100	SAMWYPE	Percept superior subordinate dead
65141120	ATTACK	Schedule perception of attack results
65250000	COMMO	Schedule percent reciever (msg)
65311001	DOGFITE	Schedule target to perceive attack
65391350	COMMAND	Schedule rendevous perception of all flights in formation
65391400	COMMAND	Schedule ground target perception
65620000	NAYBOR	Schedule perception of unit.
65621100	DESTROY	Notify CRC of Btn death
65651100	KILFLIT	Notify CRC of subordinate death
65651400	FLYSEE	Resume ground attack
65691400	AIRTHNK	Schedule resume ground attack
67671234	MADEM	Schedule red commander to begin plan of Raid.
67674141	THTRPLN	Plan next raid
69142791	SAMWYPE	Ponder superior subordinate dead
69142793	SAMWYPE	Ponder Btry superior dead
69311905	DOGFITE	Schedule dogfite outcome ponder
69342890	RELOAD	Schedule ponder Btry reload
69391375	FLY	Schedule ponder air combat
6965001	SAMSEE	Schedule ponder message
69651175	FLYSEE	Schedule interceptor message ponder
69651375	FLYSEE	Schedule Air combat ponder

MADEM EVENT CODE DEFINITIONS

EVENT CODE	SCHEDULING SUBROUTINE	EVENT
69651400	CRCEVNT	Schedule CRC ponder
69651410	CRCEVENT	Movement event code
69651420	CRCEVNT	Loss of sight
69651460	CRCSEE	Message from Airbase
69651470	CRCSEE	Message from interceptor
69651480	CRCSEE	Message from BTN
69652790	SAMSEE	Schedule ponder flight death
69652800	BYTKCHK	Ponder track move
69652805	BYTKCHK	Ponder track lost
69692700	ACCEPT	Ponder CE track info digest
69692700	BNLALLE	Schedule digest event
69692700	FILERUP	Schedule ponder digest
69692700	NEWPERC	Schedule ponder CE (track info digest)
69692700	READIL	Schedule ponder Btry digest
69692700	SAMATON	Schedule ponder Sam (Track info digest)
69692700	SDIGEST	Ponder CE Digest track info
69692705	CHKCOV	Ponder BTN delayed action
69692705	SEEKENG	Ponder BTN delayed action
69692705	SEEKTAC	Ponder BTN delayed action
69692710	BYNWTRK	Ponder Btry last chance
69692710	BTHEDUP	Schedule new last chance event
69692710	BYCONHD	Schedule ponder Btry last chance
69692710	BTRYTNK	Last chance event
69692710	BNPONBB	Schedule ponder BTN last chance event
69692710	CHKLAST	Ponder BTN last chance

MADEM EVENT CODE DEFINITIONS

EVENT CODE	SCHEDULING SUBROUTINE	EVENT
69692710	PREPAFU	Schedule ponder Btry last chance
69692710	SETASSN	Ponder BTN chance gone
69692715	ACCEPT	Schedule expected sighting
69692715	BTRYTNK	Reschedule expected sighting event
69692720	CHKCOV	Schedule opportunity knocks event
69692720	BNPONBB	Schedule opportunity knocks event
69692890	ADASASS	Schedule 1st reload/resupply for each fire unit
69692890	BYPONRL	Schedule next reload
69692895	RESUPLY	Schedule ponder Btry resupply
69952790	UMPIRE	Schedule ponder Btry flight death
69952792	NUKBLND	Schedule ponder BTN (subordinate) cut off)
69952794	NUKBLND	Schedule ponder Btry (superior cut off)
69952880	UMPIRE	Schedule ponder Btry engagement results
69992793	CRCDIES	Schedule superior death event for subordinate
93651312	ABSEE	No launch event scheduled. Schedule launch event
93651984	ABSEE	Schedule tower to land flight
93671313	ACFRAG	Schedule takeoff for flight
93931312	GOGETEM	Schedule another flight for tower to launch
93931312	TOWER	Notify commander of flight landing
95343000	ENGAGE	Schedule UMPIRE

APPENDIX G
RANDOM NUMBER GENERATOR CALLS

MADEM uses the random number generator RANF in all of its' MONTE-CARLO actions. The seed for this uniform random number generator is set using the routine RSEED. Both RANE and RSEED are CDC supplied routines.

ALL USES OF RANF AND RSEED IN MADEM

SUBROUTINE	RANF LINE NUMBERS	RSEED LINE NUMBER	COMMENTS
AIRTANK	70	70	R
ATTACK	81	81	R
CANDTGT	75	75	R
CLIST	--	43	R
CRCEVENT	98	98	R
CRCTRAK	83	83	R
DETECT	89	89	R
DOGFITE	72	72	R
FILERUP	28	28	R
GNDLOOK	35	35	R
NEWMOVE	29	29	R Problem of Error Increases Over Time
OUTPTRS	--	27	R
PTRAND	16, 33, 38	16, 33, 38	R
RELEASE	--	22, 34, 45	(Writes) R
SCHEDUL	38, 50	38, 50	R
SDIGEST	58	58	R
SHRKILL	30	30	R
VMPIRE	37	37, 37, 39	RSEED=RANCRSEED (SET)

R = reference only
SET = RSEED set in the subroutine

APPENDIX H

MADEM SUBROUTINE REFERENCE LISTS AND CALLING HIERARCHIES

1. Preprocessor

LIST OF SUBROUTINES - MADEM PAGE 1

1. ABQUEUE
2. ABVSCOR
3. ACFRAG
4. ADASASS
5. ADDBLOK
6. ADDCHR
7. ADUMP
8. APCEL1
9. APCEL2
10. ASSIGN
11. ATTACK
12. AVAILBL
13. BDALT
14. BDLEX
15. BDLRK
16. BDPARS
17. BLKDAT
18. CANDTGT
19. CARD
20. CENTER
21. CHRGEN
22. CLIST
23. CLIST2
24. CLOSCOR
25. CODE01
26. CODE03
27. CODE05
28. CODE18
29. COMMO
30. CONTROL
31. CORBOUN
32. CREATE
33. CRFLTML
34. DBGREAD
35. DECOMS
36. DELADD
37. DGTSMX
38. DISPABQ
39. DISPACD
40. DISPACL
41. DISPACR
42. DISPADS
43. DISPAQD
44. DISPDAT
45. DISPFDB
46. DISPFLT
47. DISPFMF
48. DISPPAF
49. DISPPAY
50. DISPPRO
51. DISPPYB
52. DMSDEC

53. DOGFITE
54. DROPBLK
55. ENGAGE
56. ENTRYP
57. ENTSTAT
58. EOF
59. ERROR
60. EXITP
61. EXTSCN
62. FELDEL
63. FETCH
64. FINDBLK
65. FINDFLT
66. FLTGEOM
67. FLY
68. FORMTGT
69. FSDUMP
70. FSINIT
71. GETHEX
72. GETPTRS
73. GIMME
74. HALT
75. HEXADD
76. HEXCHZ
77. HEXDIST
78. HEXINV
79. HEXMLT
80. HEXMULT
81. HISTORY
82. HLTPNT
83. HOLD
84. HXDGTS
85. HXMLT2
86. ICHECK
87. IJ2HX
88. INIT
89. INITACQ
90. IPJL
91. ISDUMP
92. ISHIFT
93. ITRAP
94. JGESUIT
95. JTJ
96. JUGGLE
97. KOMPARE
98. LACELL
99. LCMLOC
100. LEXAN
101. LINEX
102. LNPLOT
103. LOADPL
104. LOOKUP
105. LRKPRS
106. LTREE
107. LTRMRG

108. MADEM
109. MASKER
110. MESAGE
111. NAYBOR
112. NOWUCIT
113. NXTSYM
114. OPTPTH
115. OTHRDAT
116. OUTA
117. OUTPTRS
118. PACK
119. PAGE
120. PELADD
121. PERCEPT
122. PLAN
123. PLANOUT
124. PONDER
125. PTREE
126. PTRMRG
127. RDCELL
128. RECCON
129. RECER
130. RECOVR
131. RELEASE
132. RELIST
133. RENDEVU
134. REVISE
135. RITEI
136. RITEP
137. RITER
138. RLABDB
139. RLCORD
140. RLFMAKT
141. RLRATD
142. RLTGTAK
143. RLTGTYP
144. RLWAVE
145. ROUTER
146. SCHEDUL
147. SCHTAB
148. SECOND
149. SELECT
150. SEMANT
151. SHUFFLE
152. SNAP
153. SRCHPL
154. TGTGONE
155. TGTLIST
156. THH2PS
157. THTRPLN
158. THX2XY
159. TH2HX
160. TLL2HX
161. TLL2XY
162. TOWER

163. TRACE
164. TRPRMT
165. TRPRNT
166. TRPRRT
167. TTIME
168. TXY2HX
169. TXY2HXL
170. TXY2LL
171. UMPIRE
172. UNPACK
173. UNSNAP
174. UOLLOAD
175. WIPEOUT
176. XSHIFT

LIST OF FORTRAN LIBRARY ROUTINES - MADEM

1. ALOG.
2. ASIN.
3. ATAN2.
4. ATAN.
5. COS.
6. DECODI.
7. ENDFIL.
8. END.
9. GOTOER.
10. INPBI.
11. INPCI.
12. INPCR.
13. INPFI.
14. ITOJ.
15. OUTBI.
16. OUTCI.
17. OUTCR.
18. QINTRY.
19. RANDOM.
20. REWIND.
21. SIN.
22. STOP.
23. TAN.
24. TAPE6#
25. XTOI.

SUBROUTINE REFERENCE LIST - MADEM

	CALLS:	CALLED BY:
1. ABQUEUE	ENTRYP GIMME ADDBLOK FINDBLK EXITP	CODE05 CODE03
2. ABVSCOR	ENTRYP CLOSCOR GIMME ADDBLOK EXITP	REVISE
3. ACFRAG	ENTRYP GIMME CRFLTML ADDBLOK OPTPTH RELEASE FLTGEOM HEXDIST DELADD EXITP	SCHEDUL
4. ADASASS	ENTRYP GIMME FINDBLK GOTOER. DELADD ADDBLOK EXITP	CODE03
5. ADDBLOK	ENTRYP EXITP	UOLLOAD T3TLIST SEMANT OTHRDAT NOWUCIT INITACQ FINDFLT CRFLTML CANDTGT ADASASS ACFRAG ABVSCOR ABQUEUE
6. ADDCHR		

		ISHIFT TAPE6# OUTCI.		LEXAN
7. ADUMP	CALLS:	OUTCI. OUTCR.	CALLED BY:	HALT RECCON
8. APCEL1	CALLS:	ISHIFT TAPE6# OUTCI.	CALLED BY:	LRKPRS
9. APCEL2	CALLS:	ISHIFT TAPE6# OUTCI.	CALLED BY:	LRKPRS
10. ASSIGN			CALLED BY:	SELECT
11. ATTACK			CALLED BY:	SELECT
12. AVAILBL	CALLS:	ENTRYP PELADD RELEASE EXITP	CALLED BY:	THTRPLN
13. BDALT				
14. BDLEX				
15. BDLRK				
16. BDPARS				
17. BLKDAT				
18. CANDTGT	CALLS:	ENTRYP FINDBLK CLOSCOR JGESUIT FORMTGT GIMME ADDBLOK TGTGONE PTREE RANDOM. PELADD EXITP	CALLED BY:	THTRPLN
19. CARD	CALLS:		CALLED BY:	

		INPCI.		CHRGEN
		EOF		
		TAPE6#		
		OUTCI.		
20. CENTER	CALLS:		CALLED BY:	
		ENTRYP		TXY2HXL
		EXITP		TLL2HX
21. CHRGEN	CALLS:		CALLED BY:	
		CARD		LEXAN
		TAPE6#		EXTSCN
		OUTCI.		
22. CLIST	CALLS:		CALLED BY:	
		PAGE		HALT
		LNPLOT		HEXCHZ
		MESAGE		FSDUMP
		RITEP		FINDBLK
		RITER		
		RITEI		
		TAPE6#		
		OUTCI.		
		OUTCR.		
		CLIST2		
23. CLIST2	CALLS:		CALLED BY:	
		PAGE		CLIST
		LNPLOT		
		MESAGE		
		RITEI		
		RITER		
		TAPE6#		
		OUTCI.		
		OUTCR.		
		RITEP		
24. CLOSCOR	CALLS:		CALLED BY:	
		ENTRYP		CANDTGT
		HEXDIST		ABVSCOR
		EXITP		
25. CODE01	CALLS:		CALLED BY:	
		ENTRYP		SEMANT
		GIMME		
		RITEP		
		EXITP		
26. CODE03	CALLS:		CALLED BY:	
		ENTRYP		SEMANT
		SRCHPL		
		CREATE		
		LOADPL		
		RITEP		
		LNPLOT		

```
                          ABQUEUE
                          ADASASS
                          EXITP

27. CODE05           CALLS:                      CALLED BY:
                          ENTRYP                      SEMANT
                          SRCHPL
                          FINDBLK
                          GETHEX
                          RITEI
                          RITEP
                          LNPLOT
                          UOLLOAD
                          ABQUEUE
                          TGTLIST
                          INITACQ
                          HISTORY
                          EXITP

28. CODE18           CALLS:                      CALLED BY:
                          GETHEX                      SEMANT
                          GIMME
                          PACK
                          UNPACK
                          UOLLOAD
                          RITEP
                          RITEI
                          LNPLOT
                          TGTLIST
                          HISTORY

29. COMMO                                        CALLED BY:
                                                      SELECT

30. CONTROL          CALLS:                      CALLED BY:
                          ENTRYP                      MADEM
                          LTREE
                          SELECT
                          SNAP
                          UNSNAP
                          RELEASE
                          SECOND
                          HLTPNT
                          EXITP

31. CORBOUN          CALLS:                      CALLED BY:
                          ENTRYP                      THTRPLN
                          GIMME
                          THH2PS
                          TXY2HXL
                          HEXDIST
                          SIN.
                          COS.
                          LINEX
                          OPTPTH
```

```
                    EXITP

32. CREATE          CALLS:                  CALLED BY:
                         ENTRYP                       SRCHPL
                         GIMME                        CRFLTML
                         EXITP                        CODE03

33. CRFLTML         CALLS:                  CALLED BY:
                         ENTRYP                       ACFRAG
                         CREATE
                         GIMME
                         ADDBLOK
                         HISTORY
                         EXITP

34. DBGREAD         CALLS:                  CALLED BY:
                         OUTCI.                       MADEM
                         INPCI.
                         EOF
                         DECODI.

35. DECOMS

36. DELADD          CALLS:                  CALLED BY:
                         ENTRYP                       THTRPLN
                         MESAGE                       ADASASS
                         TRACE                        ACFRAG
                         RECER                        MADEM
                         GIMME
                         SNAP
                         LTRMRG
                         EXITP

37. DGTSHX          CALLS:
                         ITOJ.

38. DISPABQ         CALLS:                  CALLED BY:
                         OUTCI.                       DISPDAT

39. DISPACD         CALLS:                  CALLED BY:
                         OUTCI.                       DISPFLT
                                                      DISPDAT

40. DISPACL         CALLS:                  CALLED BY:
                         OUTCI.                       DISPACR

41. DISPACR         CALLS:                  CALLED BY:
                         OUTCI.                       DISPDAT
                         DISPACL

42. DISPADS         CALLS:                  CALLED BY:
                         OUTCI.                       DISPDAT

43. DISPAQD         CALLS:                  CALLED BY:
                         OUTCI.                       DISPFLT
```

```
44. DISPDAT          CALLS:                     CALLED BY:
                            OUTCI.                          MADEM
                            DISPADS
                            DISPFDB
                            DISPFLT
                            DISPACD
                            DISPPAF
                            DISPPRO
                            DISPAQD
                            DISPABQ
                            DISPACR

45. DISPFDB          CALLS:                     CALLED BY:
                            OUTCI.                          DISPDAT
                            DISPFMF

46. DISPFLT          CALLS:                     CALLED BY:
                            OUTCI.                          DISPFMF
                            DISPPAY                         DISPDAT
                            DISPAQD
                            DISPACD
                            DISPPRO

47. DISPFMF          CALLS:                     CALLED BY:
                            OUTCI.                          DISPFDB
                            DISPFLT

48. DISPPAF          CALLS:                     CALLED BY:
                            OUTCI.                          DISPDAT
                            DISPPYB

49. DISPPAY          CALLS:                     CALLED BY:
                            OUTCI.                          DISPFLT
                            DISPPYB

50. DISPPRO          CALLS:                     CALLED BY:
                            OUTCI.                          DISPFLT
                                                            DISPDAT

51. DISPPYB          CALLS:                     CALLED BY:
                            OUTCI.                          DISPPAY
                                                            DISPPAF

52. DMSDEC           CALLS:                     CALLED BY:
                            ENTRYP                          SEMANT
                            EXITP

53. DOGFITE                                     CALLED BY:
                                                            SELECT

54. DROPBLK          CALLS:                     CALLED BY:
                            ENTRYP                          NOWUCIT
                            RELEASE
```

```
                    EXITP

55. ENGAGE                                CALLED BY:
                                                    SELECT

56. ENTRYP              CALLS:            CALLED BY:
                              MESAGE                LTRMRG
                              RITEI                 UNPACK
                              RECER                 UOLLOAD
                              TAPE6#                UNSNAP
                              OUTCI.                TXY2HXL
                              ROUTER                TXY2HX
                              ITRAP                 TTIME
                              SECOND                TLL2HX
                                                    THX2XY
                                                    THTRPLN
                                                    THH2PS
                                                    TGTLIST
                                                    TGTGONE
                                                    SRCHPL
                                                    SNAP
                                                    SEMANT
                                                    SELECT
                                                    SCHTAB
                                                    SCHEDUL
                                                    RLWAVE
                                                    RLTGTYP
                                                    RLTGTAK
                                                    RLRAID
                                                    RLFMANT
                                                    RLCORD
                                                    RLABDB
                                                    REVISE
                                                    RENDEVU
                                                    RELIST
                                                    RELEASE
                                                    PTREE
                                                    PLANOUT
                                                    PLAN
                                                    PELADD
                                                    PACK
                                                    OUTA
                                                    OTHROAT
                                                    OPTPTH
                                                    NOWUCIT
                                                    LTREE
                                                    LOADPL
                                                    LINEX
                                                    KOMPARE
                                                    JUGGLE
                                                    JTJ
                                                    JGESUIT
                                                    INITACQ
                                                    INIT
                                                    IJ2HX
```

```
                                                                    HXDGTS
                                                                    HOLD
                                                                    HLTPNT
                                                                    HISTORY
                                                                    HEXMULT
                                                                    HEXMLT
                                                                    HEXINV
                                                                    HEXCHZ
                                                                    HEXADD
                                                                    GIMME
                                                                    GETPTRS
                                                                    GETHEX
                                                                    FSINIT
                                                                    FSDUMP
                                                                    FORMTGT
                                                                    FLTGEOM
                                                                    FINDFLT
                                                                    FINDBLK
                                                                    FETCH
                                                                    DROPBLK
                                                                    DMSDEC
                                                                    DELADD
                                                                    CRFLTML
                                                                    CREATE
                                                                    CORBOUN
                                                                    CONTROL
                                                                    CODE05
                                                                    CODE03
                                                                    CODE01
                                                                    CLOSCOR
                                                                    CENTER
                                                                    CANDTGT
                                                                    AVAILBL
                                                                    ADDBLOK
                                                                    ADASASS
                                                                    ACFRAG
                                                                    ABVSCOR
                                                                    ABQUEUE
                                                                    MADEM
57. ENTSTAT          CALLS:                      CALLED BY:
                            TAPE6#                          HALT
                            OUTCI.                          FSDUMP

58. EOF                                          CALLED BY:
                                                            DBGREAD
                                                            CARD

59. ERROR            CALLS:                      CALLED BY:
                            TAPE6#                          LRKPRS
                            OUTCI.

60. EXITP            CALLS:                      CALLED BY:
                            SECOND                          LTRMRG
                            MESAGE                          UNPACK
```

```
RITEI        UOLLOAD
RECER        UNSNAP
TAPE6#       TXY2HXL
OUTCI.       TXY2HX
ITRAP        TTIME
ICHECK       TLL2HX
             THX2XY
             THTRPLN
             THH2PS
             TGTLIST
             TGTGONE
             SRCHPL
             SNAP
             SEMANT
             SELECT
             SCHTAB
             SCHEDUL
             RLWAVE
             RLTGTYP
             RLTGTAK
             RLRAID
             RLFMAKT
             RLCORD
             RLABDB
             REVISE
             RENDEVU
             RELIST
             RELEASE
             PTREE
             PLANOUT
             PLAN
             PELADD
             PACK
             OUTA
             OTHRDAT
             OPTPTH
             NOWUCIT
             LTREE
             LOADPL
             LINEX
             KOMPARE
             JUGGLE
             JTJ
             JGESUIT
             INITACQ
             INIT
             IJ2HX
             HXDGTS
             HOLD
             HLTPNT
             HISTORY
             HEXMULT
             HEXMLT
             HEXINV
             HEXCHZ
```

			HEXADD
			GIMME
			GETPTRS
			GETHEX
			FSINIT
			FSDUMP
			FORMTGT
			FLTGEOM
			FINDFLT
			FINDBLK
			FETCH
			DROPBLK
			DMSDEC
			DELADD
			CRFLTML
			CREATE
			CORBOUN
			CONTROL
			CODE05
			CODE03
			CODE01
			CLOSCOR
			CENTER
			CANDTGT
			AVAILBL
			ADDBLOK
			ADASASS
			ACFRAG
			ABVSCOR
			ABQUEUE
			MADEM
61. EXTSCN	CALLS:	CALLED BY:	
	CHRGEN		LEXAN
	ITOJ.		
62. FELDEL		CALLED BY:	
			SELECT
63. FETCH	CALLS:	CALLED BY:	
	ENTRYP		MADEM
	INPBI.		
	EXITP		
64. FINDBLK	CALLS:	CALLED BY:	
	ENTRYP		THTRPLN
	ROUTER		T3TLIST
	MESAGE		SEMANT
	RITEI		OTHRDAT
	CLIST		NOWUCIT
	EXITP		FORMTGT
			FINDFLT
			CODE05
			CANDTGT
			ADASASS

65. FINDFLT	CALLS:	CALLED BY:
	ENTRYP	FORMTGT
	HEXDIST	
	FINDBLK	
	KOMPARE	
	GIMME	
	ADDBLOK	
	EXITP	
66. FLTGEOM	CALLS:	CALLED BY:
	ENTRYP	ACFRAG
	HEXCHZ	
	THH2PS	
	ATAN2.	
	EXITP	
67. FLY		CALLED BY:
		SELECT
68. FORMTGT	CALLS:	CALLED BY:
	ENTRYP	CANDTGT
	GIMME	
	FINDBLK	
	FINDFLT	
	RELEASE	
	EXITP	
69. FSDUMP	CALLS:	CALLED BY:
	ENTRYP	JTJ
	TRACE	
	ENTSTAT	
	CLIST	
	RITER	
	LNPLOT	
	LCMLOC	
	TAPE6#	
	OUTCI.	
	OUTCR.	
	EXITP	
70. FSINIT	CALLS:	CALLED BY:
	ENTRYP	MADEM
	EXITP	
71. GETHEX	CALLS:	CALLED BY:
	ENTRYP	TXY2HXL
	HXDGTS	SEMANT
	MESAGE	SCHEDUL
	RITEI	NOWUCIT
	GIMME	HEXCHZ
	SCHTAB	CODE18
	EXITP	CODE05

	CALLS:	CALLED BY:
72. GETPTRS	ENTRYP	PLAN
	EXITP	
73. GIMME	ENTRYP	UOLLOAD
	HALT	TGTLIST
	MESAGE	TGTGONE
	RITEI	SEMANT
	RITEP	REVISE
	EXITP	RELEASE
		PELADD
		OTHRDAT
		OPTPTH
		NOWUCIT
		INITACQ
		INIT
		GETHEX
		FORMTGT
		FINDFLT
		DELADD
		CRFLTML
		CREATE
		CORBOUN
		CODE18
		CODE01
		CANDTGT
		ADASASS
		ACFRAG
		ABVSCOR
		ABQUEUE
74. HALT	HOLD	UNPACK
	OUTCI.	ITRAP
	RITER	RECCON
	RITEI	SELECT
	TRACE	RELEASE
	RECER	PACK
	ENTSTAT	OTHRDAT
	CLIST	HLTPNT
	PAGE	GIMME
	ADUMP	MADEM
	ISDUMP	
	ENDFIL.	
	STOP.	
75. HEXADD	ENTRYP	SCHEDUL
	ITOJ.	NOWUCIT
	EXITP	HEXMLT
		HEXCHZ
76. HEXCHZ		

	CALLS:	CALLED BY:
	ENTRYP	OPTPTH
	TRACE	FLTGEOM
	MESAGE	
	RITEP	
	CLIST	
	HEXADD	
	HEXINV	
	GETHEX	
	EXITP	
77. HEXDIST		CALLED BY:
		SCHEDUL
		FINDFLT
		CORBOUN
		CLOSCOR
		ACFRAG
78. HEXINV	CALLS:	CALLED BY:
	ENTRYP	HEXCHZ
	ITOJ.	
	EXITP	
79. HEXMLT	CALLS:	CALLED BY:
	HEXADD	IJ2HX
	ENTRYP	
	HXDGTS	
	MESAGE	
	RITEI	
	EXITP	
80. HEXMULT	CALLS:	CALLED BY:
	ENTRYP	NOWUCIT
	ITOJ.	
	EXITP	
81. HISTORY	CALLS:	CALLED BY:
	ENTRYP	CRFLTML
	MESAGE	CODE18
	MASKER	CODE05
	TAPE6#	
	OUTCI.	
	EXITP	
82. HLTPNT	CALLS:	CALLED BY:
	ENTRYP	CONTROL
	SECOND	
	HALT	
	EXITP	
83. HOLD	CALLS:	CALLED BY:
	ENTRYP	HALT
	OUTBI.	
	REWIND.	
	EXITP	

```
84. HXDGTS          CALLS:                    CALLED BY:
                          ENTRYP                        TH2HX
                          EXITP                         THX2XY
                                                        HEXMLT
                                                        GETHEX

85. HXMLT2          CALLS:
                          TH2HX
                          IJ2HX

86. ICHECK          CALLS:                    CALLED BY:
                          OUTCI.                        EXITP

87. IJ2HX           CALLS:                    CALLED BY:
                          HEXMLT                        TXY2HXL
                          ENTRYP                        TLL2HX
                          ITOJ.                         HXMLT2
                          EXITP

88. INIT            CALLS:                    CALLED BY:
                          ENTRYP                        MADEM
                          XTOI.
                          GIMME
                          RITEP
                          SNAP
                          EXITP

89. INITACQ         CALLS:                    CALLED BY:
                          ENTRYP                        CODE05
                          GIMME
                          ADDBLOK
                          ALOG.
                          MESAGE
                          RITEI
                          XTOI.
                          NOWUCIT
                          EXITP

90. IPJL            CALLS:
                          LCMLOC
                          ISHIFT
                          TAPE6#
                          OUTCI.

91. ISDUMP          CALLS:                    CALLED BY:
                          OUTCI.                        HALT
                          OUTCR.                        UNPACK
                                                        PACK

92. ISHIFT                                    CALLED BY:
                                                        APCEL2
                                                        LACELL
                                                        APCEL1
                                                        ROCELL
```

```
                                                                ADDCHR
                                                                LOOKUP
                                                                LRKPRS
                                                                LEXAN
                                                                PTREE
                                                                JTJ
                                                                IPJL
 93. ITRAP              CALLS:                      CALLED BY:
                                HALT                            EXITP
                                                                ENTRYP
                                                                THTRPLN
 94. JGESUIT            CALLS:                      CALLED BY:
                                ENTRYP                          CANDTGT
                                THX2XY
                                ATAN2.
                                EXITP
 95. JTJ                CALLS:
                                ENTRYP
                                MESAGE
                                RITEI
                                ISHIFT
                                TAPE6#
                                OUTCI.
                                FSDUMP
                                STOP.
                                EXITP
 96. JUGGLE             CALLS:                      CALLED BY:
                                ENTRYP                          THX2XY
                                EXITP
 97. KOMPARE            CALLS:                      CALLED BY:
                                ENTRYP                          THTRPLN
                                UNPACK                          FINDFLT
                                PACK
                                EXITP
 98. LACELL             CALLS:                      CALLED BY:
                                ISHIFT                          LRKPRS
                                TAPE6#
                                OUTCI.
 99. LCMLOC                                         CALLED BY:
                                                                UNPACK
                                                                RITEP
                                                                PACK
                                                                IPJL
                                                                FSDUMP
                                                                MADEM
100. LEXAN              CALLS:                      CALLED BY:
                                CHRGEN                          NXTSYM
```

```
                         ISHIFT
                         GOTOER.
                         ADDCHR
                         LOOKUP
                         EXTSCN
                         TAPE6#
                         OUTCI.
101. LINEX          CALLS:                    CALLED BY:
                         ENTRYP                        OPTPTH
                         EXITP                         CORBOUN
102. LNPLOT         CALLS:                    CALLED BY:
                         TAPE6#                        CLIST2
                         OUTCI.                        SEMANT
                                                       OUTPTRS
                                                       FSDUMP
                                                       CODE18
                                                       CODE05
                                                       CODE03
                                                       CLIST
103. LOADPL         CALLS:                    CALLED BY:
                         ENTRYP                        CODE03
                         EXITP
104. LOOKUP         CALLS:                    CALLED BY:
                         ISHIFT                        LEXAN
                         TAPE6#
                         OUTCI.
105. LRXPRS         CALLS:                    CALLED BY:
                         SEMANT                        MADEM
                         TAPE6#
                         OUTCI.
                         RDCELL
                         NXTSYM
                         ERROR
                         ISHIFT
                         APCEL1
                         APCEL2
                         LACELL
106. LTREE          CALLS:                    CALLED BY:
                         ENTRYP                        CONTROL
                         RELEASE
                         LTRMRG
                         EXITP
107. LTRMRG         CALLS:                    CALLED BY:
                         ENTRYP                        LTREE
                         EXITP                         DELADD
108. MADEM          CALLS:
                         QINTRY.
```

```
                              RECCON
                              ENTRYP
                              INPFI.
                              DBGREAD
                              RECOVR
                              GOTOER.
                              FETCH
                              PAGE
                              LCMLOC
                              FSINIT
                              OTHRDAT
                              DISPDAT
                              HALT
                              INIT
                              LRKPRS
                              RELIST
                              DELADD
                              CONTROL
                              EXITP
                              END.
109. MASKER                                       CALLED BY:
                                                           HISTORY

110. MESAGE            CALLS:                     CALLED BY:
                              TAPE6#                       CLIST2
                              OUTCI.                       EXITP
                                                           ENTRYP
                                                           SELECT
                                                           RELEASE
                                                           PACK
                                                           OUTPTRS
                                                           JTJ
                                                           INITACQ
                                                           HISTORY
                                                           HEXMLT
                                                           HEXCHZ
                                                           GIMME
                                                           GETHEX
                                                           FINDBLK
                                                           DELADD
                                                           CLIST
111. NAYBOR                                       CALLED BY:
                                                           SELECT

112. NOWUCIT           CALLS:                     CALLED BY:
                              ENTRYP                       INITACQ
                              HEXADD
                              HEXMULT
                              GETHEX
                              GIMME
                              ADDBLOK
                              FINDBLK
                              DROPBLK
```

```
                         RELEASE
                         EXITP

113. NXTSYM          CALLS:                      CALLED BY:
                         LEXAN                           LRKPRS
                         TAPE6#
                         OUTCI.

114. OPTPTH          CALLS:                      CALLED BY:
                         ENTRYP                          CORBOUN
                         GIMME                           ACFRAG
                         THM2PS
                         HEXCHZ
                         LINEX
                         EXITP

115. OTHRDAT         CALLS:                      CALLED BY:
                         ENTRYP                          MADEM
                         GIMME
                         INPCI.
                         TAPE6#
                         OUTCI.
                         RITEP
                         ADDBLOK
                         INPFI.
                         FINDBLK
                         HALT
                         EXITP

116. OUTA            CALLS:
                         ENTRYP
                         TAPE6#
                         OUTCI.
                         EXITP

117. OUTPTRS         CALLS:
                         LNPLOT
                         MESAGE
                         RITEI
                         RITER
                         RITEP
                         UNPACK

118. PACK            CALLS:                      CALLED BY:
                         ENTRYP                          SEMANT
                         LCMLOC                          KOMPARE
                         PAGE                            CODE18
                         MESAGE
                         RITEI
                         TRACE
                         ROUTER
                         RITEP
                         ISDUMP
                         HALT
                         EXITP
```

119. PAGE	CALLS: TAPE6# OUTCI.	CALLED BY: CLIST2 HALT PACK CLIST MADEM
120. PELADD	CALLS: ENTRYP GIMME PTRMRG EXITP	CALLED BY: TGTLIST CANDTGT AVAILBL
121. PERCEPT		CALLED BY: SELECT
122. PLAN	CALLS: ENTRYP GETPTRS THTRPLN EXITP	CALLED BY: SELECT
123. PLANOUT	CALLS: ENTRYP OUTCI. EXITP	CALLED BY: THTRPLN
124. PONDER		CALLED BY: SELECT
125. PTREE	CALLS: ENTRYP RELEASE ISHIFT EXITP	CALLED BY: TGTGONE CANDTGT
126. PTRMRG		CALLED BY: PELADD
127. RDCELL	CALLS: ISHIFT TAPE6# OUTCI.	CALLED BY: LRKPRS
128. RECCON	CALLS: TAPE6# OUTCI. ADUMP HALT	CALLED BY: MADEM
129. RECER	CALLS: TAPE6# OUTCI. OUTCR.	CALLED BY: HALT EXITP ENTRYP

DELADD

```
130. RECOVR                                   CALLED BY:
                                                   MADEM

131. RELEASE           CALLS:                 CALLED BY:
                            ENTRYP                 RLWAVE
                            MESAGE                 RLTGTYP
                            RITEI                  RLTGTAK
                            RITEP                  RLRAID
                            HALT                   RLFMAKT
                            GIMME                  RLCORD
                            EXITP                  RLABDB
                                                   REVISE
                                                   RELIST
                                                   PTREE
                                                   NOWUCIT
                                                   LTREE
                                                   FORMTGT
                                                   DROPBLK
                                                   CONTROL
                                                   AVAILBL
                                                   ACFRAG

132. RELIST            CALLS:                 CALLED BY:
                            ENTRYP                 MADEM
                            RELEASE
                            EXITP

133. RENDEVU           CALLS:                 CALLED BY:
                            ENTRYP                 SCHEDUL
                            THX2XY
                            TXY2HXL
                            EXITP

134. REVISE            CALLS:                 CALLED BY:
                            ENTRYP                 THTRPLN
                            GIMME
                            ABVSCOR
                            RELEASE
                            EXITP

135. RITEI             CALLS:                 CALLED BY:
                            TAPE6#                 CLIST2
                            OUTCI.                 HALT
                                                   EXITP
                                                   ENTRYP
                                                   SEMANT
                                                   SELECT
                                                   RELEASE
                                                   PACK
                                                   OUTPTRS
                                                   JTJ
                                                   INITACQ
                                                   HEXMLT
```

```
                                                    GIMME
                                                    GETHEX
                                                    FINDBLK
                                                    CODE18
                                                    CODE05
                                                    CLIST
136. RITEP           CALLS:               CALLED BY:
                           LCMLOC                   CLIST2
                           TAPE6#                   UNPACK
                           OUTCI.                   SEMANT
                                                    RELEASE
                                                    PACK
                                                    OUTPTRS
                                                    OTHRDAT
                                                    INIT
                                                    HEXCHZ
                                                    GIMME
                                                    CODE18
                                                    CODE05
                                                    CODE03
                                                    CODE01
                                                    CLIST
137. RITER           CALLS:               CALLED BY:
                           TAPE6#                   CLIST2
                           OUTCI.                   HALT
                                                    SEMANT
                                                    OUTPTRS
                                                    FSDUMP
                                                    CLIST
138. RLAB08          CALLS:               CALLED BY:
                           ENTRYP                   RLCORD
                           RELEASE
                           EXITP
139. RLCORD          CALLS:               CALLED BY:
                           ENTRYP                   RLRAID
                           RLAB08
                           RELEASE
                           EXITP
140. RLFMAKT         CALLS:               CALLED BY:
                           ENTRYP                   RLTGTAK
                           RELEASE
                           EXITP
141. RLRAID          CALLS:               CALLED BY:
                           ENTRYP                   THTRPLN
                           RLWAVE
                           RLCORD
                           RELEASE
                           EXITP
```

```
142. RLTGTAK          CALLS:                     CALLED BY:
                              ENTRYP                           RLTGTYP
                              RLFMAKT
                              RELEASE
                              EXITP

143. RLTGTYP          CALLS:                     CALLED BY:
                              ENTRYP                           RLWAVE
                              RELEASE
                              RLTGTAK
                              EXITP

144. RLWAVE           CALLS:                     CALLED BY:
                              ENTRYP                           RLRAID
                              RLTGTYP
                              RELEASE
                              EXITP

145. ROUTER           CALLS:                     CALLED BY:
                              TAPE6#                           ENTRYP
                              OUTCI.                           PACK
                              OUTCR.                           FINDBLK

146. SCHEDUL          CALLS:                     CALLED BY:
                              ENTRYP                           THTRPLN
                              UNPACK
                              RANDOM.
                              RENDEVU
                              HEXADD
                              GETHEX
                              HEXDIST
                              ACFRAG
                              EXITP

147. SCHTAB           CALLS:                     CALLED BY:
                              ENTRYP                           GETHEX
                              EXITP

148. SECOND                                      CALLED BY:
                                                               EXITP
                                                               ENTRYP
                                                               HLTPNT
                                                               CONTROL

149. SELECT           CALLS:                     CALLED BY:
                              ENTRYP                           CONTROL
                              GOTOER.
                              MESAGE
                              RITEI
                              HALT
                              FELDEL
                              ASSIGN
                              ATTACK
                              COMMO
```

```
                        DOGFITE
                        ENGAGE
                        FLY
                        NAYBOR
                        PERCEPT
                        PLAN
                        PONDER
                        TOWER
                        UMPIRE
                        TAPE6#
                        OUTCI.
                        OUTCR.
                        EXITP
150. SEMANT       CALLS:                CALLED BY:
                        ENTRYP                      LRKPRS
                        GOTOER.
                        CODE01
                        GIMME
                        PACK
                        RITEI
                        RITEP
                        LNPLOT
                        CODE03
                        GETHEX
                        CODE05
                        DMSDEC
                        TLL2HX
                        INPCI.
                        INPCR.
                        TAPE6#
                        OUTCI.
                        OUTCR.
                        ADDBLOK
                        TTIME
                        RITER
                        FINDBLK
                        CODE18
                        XTOI.
                        SRCHPL
                        EXITP
151. SHUFFLE                            CALLED BY:
                                                    TH2HX
152. SNAP         CALLS:                CALLED BY:
                        ENTRYP                      INIT
                        EXITP                       DELADD
                                                    CONTROL
153. SRCHPL       CALLS:                CALLED BY:
                        ENTRYP                      SEMANT
                        CREATE                      CODE05
                        EXITP                       CODE03
```

No.	Routine	Calls	Called by
154.	TGTGONE	ENTRYP	CANDTGT
		PTREE	
		GIMME	
		EXITP	
155.	TGTLIST	ENTRYP	CODE18
		FINDBLK	CODE05
		GIMME	
		ADDBLOK	
		DELADD	
		EXITP	
156.	THH2PS	ENTRYP	OPTPTH
		THX2XY	FLTGEOM
		EXITP	CORBOUN
157.	THTRPLN	ENTRYP	PLAN
		CORBOUN	
		REVISE	
		FINDBLK	
		KOMPARE	
		CANDTGT	
		ITRAP	
		AVAILBL	
		SCHEDUL	
		DELADD	
		PLANOUT	
		RLRAID	
		EXITP	
158.	THX2XY	ENTRYP	THH2PS
		HXDGTS	RENDEVU
		JUGGLE	JGESUIT
		EXITP	
159.	TH2HX	HXDGTS	HXMLT2
		SHUFFLE	
160.	TLL2HX	ENTRYP	SEMANT
		SIN.	
		TAN.	
		TXY2HX	
		CENTER	
		IJ2HX	
		EXITP	
161.	TLL2XY		

```
                                SIN.
                                TAN.

162. TOWER                                              CALLED BY:
                                                              SELECT

163. TRACE               CALLS:                         CALLED BY:
                                TRPRRT                        HALT
                                TRPRMT                        PACK
                                TRPRNT                        HEXCHZ
                                                              FSDUMP
                                                              DELADD

164. TRPRMT                                             CALLED BY:
                                                              TRACE

165. TRPRNT              CALLS:                         CALLED BY:
                                TAPE6#                        TRACE
                                OUTCI.

166. TRPRRT                                             CALLED BY:
                                                              TRACE

167. TTIME               CALLS:                         CALLED BY:
                                ENTRYP                        SEMANT
                                EXITP

168. TXY2HX              CALLS:                         CALLED BY:
                                ENTRYP                        TLL2HX
                                EXITP

169. TXY2HXL             CALLS:                         CALLED BY:
                                ENTRYP                        RENDEVU
                                COS.                          CORBOUN
                                SIN.
                                XTOI.
                                CENTER
                                IJ2HX
                                GETHEX
                                EXITP

170. TXY2LL              CALLS:
                                ASIN.
                                ATAN.

171. UMPIRE                                             CALLED BY:
                                                              SELECT

172. UNPACK              CALLS:                         CALLED BY:
                                ENTRYP                        SCHEDUL
                                LCMLOC                        OUTPTRS
                                RITEP                         KOMPARE
                                ISDUMP                        CODE18
                                HALT
                                EXITP
```

```
173. UNSNAP          CALLS:                    CALLED BY:
                           ENTRYP                    CONTROL
                           EXITP

174. UOLLOAD         CALLS:                    CALLED BY:
                           ENTRYP                    CODE18
                           GIMME                     CODE05
                           ADDBLOK
                           EXITP

175. WIPEOUT

176. XSHIFT
```

1. ALOG.	CALLED BY:	INITACQ
2. ASIN.	CALLED BY:	TXY2LL
3. ATAN2.	CALLED BY:	JGESUIT FLTGEOM
4. ATAN.	CALLED BY:	TXY2LL
5. COS.	CALLED BY:	TXY2HXL CORBOUN
6. DECODI.	CALLED BY:	DBGREAD
7. ENDFIL.	CALLED BY:	HALT
8. END.	CALLED BY:	MADEM
9. GOTOER.	CALLED BY:	LEXAN SEMANT SELECT ADASASS MADEM
10. INPBI.	CALLED BY:	FETCH
11. INPCI.	CALLED BY:	DBGREAD CARD SEMANT OTHRDAT
12. INPCR.	CALLED BY:	SEMANT
13. INPFI.	CALLED BY:	OTHRDAT MADEM
14. ITOJ.	CALLED BY:	EXTSCN

```
                                        IJ2HX
                                        HEXMULT
                                        HEXINV
                                        HEXADD
                                        DGTSHX
15. OUTBI.                         CALLED BY:
                                        HOLD
16. OUTCI.                         CALLED BY:
                                        CLIST2
                                        ISDUMP
                                        HALT
                                        ADUMP
                                        DBGREAD
                                        ICHECK
                                        DISPPYB
                                        DISPPRO
                                        DISPPAY
                                        DISPPAF
                                        DISPFMF
                                        DISPFLT
                                        DISPFDB
                                        DISPAQD
                                        DISPADS
                                        DISPACR
                                        DISPACL
                                        DISPACD
                                        DISPABQ
                                        DISPDAT
                                        EXITP
                                        ENTRYP
                                        ENTSTAT
                                        ROUTER
                                        RECER
                                        RECCON
                                        NXTSYM
                                        APCEL2
                                        LACELL
                                        APCEL1
                                        RDCELL
                                        CARD
                                        CHRGEN
                                        ERROR
                                        ADDCHR
                                        LOOKUP
                                        LRKPRS
                                        LEXAN
                                        TRPRNT
                                        SEMANT
                                        SELECT
                                        RITER
                                        RITEP
                                        RITEI
                                        PLANOUT
```

```
                                                    PAGE
                                                    OUTA
                                                    OTHRDAT
                                                    MESAGE
                                                    LVPLOT
                                                    JTJ
                                                    IPJL
                                                    HISTORY
                                                    FSDUMP
                                                    CLIST
17. OUTCR.                                 CALLED BY:
                                                    CLIST2
                                                    ISDUMP
                                                    ADUMP
                                                    ROUTER
                                                    RECER
                                                    SEMANT
                                                    SELECT
                                                    FSDUMP
                                                    CLIST
18. QINTRY.                                CALLED BY:
                                                    MADEM
19. RANDOM.                                CALLED BY:
                                                    SCHEDUL
                                                    CANDTGT
20. REWIND.                                CALLED BY:
                                                    HOLD
21. SIN.                                   CALLED BY:
                                                    TXY2HXL
                                                    TLL2XY
                                                    TLL2HX
                                                    CORBOUN
22. STOP.                                  CALLED BY:
                                                    HALT
                                                    JTJ
23. TAN.                                   CALLED BY:
                                                    TLL2XY
                                                    TLL2HX
24. TAPE6=                                 CALLED BY:
                                                    CLIST2
                                                    EXITP
                                                    ENTRYP
                                                    ENTSTAT
                                                    ROUTER
                                                    RECER
                                                    RECCON
                                                    NXTSYM
```

```
                                              APCEL2
                                              LACELL
                                              APCEL1
                                              ROCELL
                                              CARD
                                              CHRGEN
                                              ERROR
                                              ADDCHR
                                              LOOKUP
                                              LRKPRS
                                              LEXAN
                                              TRPRNT
                                              SEMANT
                                              SELECT
                                              RITER
                                              RITEP
                                              RITEI
                                              PAGE
                                              OUTA
                                              OTHRDAT
                                              MESAGE
                                              LNPLOT
                                              JTJ
                                              IPJL
                                              HISTORY
                                              FSDUMP
                                              CLIST
25. XTOI.                         CALLED BY:
                                              TXY2HXL
                                              SEMANT
                                              INITACQ
                                              INIT
```

```
00001      1. MADEM
00002         2. QINTRY.
00003         2. RECCON
00004            3. TAPE6#
00005            3. OUTCI.
00006            3. ADUMP
00007               4. OUTCI.
00008               4. OUTCR.
00009            3. HALT
00010               4. HOLD
00011                  5. ENTRYP
00012                     6. MESAGE
00013                        7. TAPES#
00014                        7. OUTCI.
00015                     6. RITEI
00016                        7. TAPES#
00017                        7. OUTCI.
00018                     6. RECER
00019                        7. TAPES#
00020                        7. OUTCI.
00021                        7. OUTCR.
00022                     6. TAPE6#
00023                     6. OUTCI.
00024                     6. ROUTER
00025                        7. TAPES#
00026                        7. OUTCI.
00027                        7. OUTCR.
00028                     6. ITRAP
00029                        7. HALT          (SEE LINE 00009)
00030                     6. SECOND
00031                  5. OUTBI.
00032                  5. REWIND.
00033                  5. EXITP
00034                     6. SECOND
00035                     6. MESAGE      (SEE LINE 00012)
00036                     6. RITEI       (SEE LINE 00015)
00037                     6. RECER       (SEE LINE 00018)
00038                     6. TAPE6#
00039                     6. OUTCI.
00040                     6. ITRAP       (SEE LINE 00028)
00041                     6. ICHECK
00042                        7. OUTCI.
00043               4. OUTCI.
00044               4. RITER
00045                  5. TAPE6#
00046                  5. OUTCI.
00047               4. RITEI        (SEE LINE 00015)
00048               4. TRACE
00049                  5. TRPRRT
00050                  5. TRPRMT
00051                  5. TRPRNT
00052                     6. TAPE6#
```

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00053                 6. OUTCI.
00054             4. RECER        (SEE LINE 00018)
00055             4. ENTSTAT
00056               5. TAPE6#
00057               5. OUTCI.
00058             4. CLIST
00059               5. PAGE
00060                 6. TAPE6#
00061                 6. OUTCI.
00062               5. LNPLOT
00063                 6. TAPE6#
00064                 6. OUTCI.
00065               5. MESAGE       (SEE LINE 00012)
00066               5. RITEP
00067                 6. LCMLOC
00068                 6. TAPE6#
00069                 6. OUTCI.
00070               5. RITER        (SEE LINE 00044)
00071               5. RITEI        (SEE LINE 00015)
00072               5. TAPE6#
00073               5. OUTCI.
00074               5. OUTCR.
00075               5. CLIST2
00076                 6. PAGE         (SEE LINE 00059)
00077                 6. LNPLOT       (SEE LINE 00062)
00078                 6. MESAGE       (SEE LINE 00012)
00079                 6. RITEI        (SEE LINE 00015)
00080                 6. RITER        (SEE LINE 00044)
00081                 6. TAPE6#
00082                 6. OUTCI.
00083                 6. OUTCR.
00084                 6. RITEP        (SEE LINE 00066)
00085             4. PAGE         (SEE LINE 00059)
00086             4. ADUMP        (SEE LINE 00006)
00087             4. ISDUMP
00088               5. OUTCI.
00089               5. OUTCR.
00090             4. ENDFIL.
00091             4. STOP.
00092         2. ENTRYP       (SEE LINE 00011)
00093         2. INPFI.
00094         2. OBSREAD
00095           3. OUTCI.
00096           3. INPCI.
00097           3. EOF
00098           3. DECODI.
00099         2. RECOVR
00100         2. SOTOER.
00101         2. FETCH
00102           3. ENTRYP       (SEE LINE 00011)
00103           3. INPRI.
00104           3. EXITP        (SEE LINE 00033)
00105         2. PAGE         (SEE LINE 00059)
00106         2. LCMLOC
00107         2. FSINIT
```

```
00108            3. ENTRYP        (SEE LINE 00011)
00109            3. EXITP         (SEE LINE 00033)
00110         2. OTHRDAT
00111            3. ENTRYP        (SEE LINE 00011)
00112            3. GIMME
00113               4. ENTRYP        (SEE LINE 00011)
00114               4. HALT          (SEE LINE 00009)
00115               4. MESAGE        (SEE LINE 00012)
00116               4. RITEI         (SEE LINE 00015)
00117               4. RITEP         (SEE LINE 00066)
00118               4. EXITP         (SEE LINE 00033)
00119            3. INPCI.
00120            3. TAPE6=
00121            3. OUTCI.
00122            3. RITEP         (SEE LINE 00066)
00123            3. ADDBLOK
00124               4. ENTRYP        (SEE LINE 00011)
00125               4. EXITP         (SEE LINE 00033)
00126            3. INPFI.
00127            3. FINDBLK
00128               4. ENTRYP        (SEE LINE 00011)
00129               4. ROUTER        (SEE LINE 00024)
00130               4. MESAGE        (SEE LINE 00012)
00131               4. RITEI         (SEE LINE 00015)
00132               4. CLIST         (SEE LINE 00058)
00133               4. EXITP         (SEE LINE 00033)
00134            3. HALT          (SEE LINE 00009)
00135            3. EXITP         (SEE LINE 00033)
00136         2. DISPDAT
00137            3. OUTCI.
00138            3. DISPADS
00139               4. OUTCI.
00140            3. DISPFDB
00141               4. OUTCI.
00142               4. DISPFMF
00143                  5. OUTCI.
00144                  5. DISPFLT
00145                     6. OUTCI.
00146                     6. DISPPAY
00147                        7. OUTCI.
00148                        7. DISPPYB
00149                           8. OUTCI.
00150                     6. DISPAQD
00151                        7. OUTCI.
00152                     6. DISPACD
00153                        7. OUTCI.
00154                     6. DISPPRO
00155                        7. OUTCI.
00156            3. DISPFLT       (SEE LINE 00144)
00157            3. DISPACD       (SEE LINE 00152)
00158            3. DISPPAF
00159               4. OUTCI.
00160               4. DISPPYB       (SEE LINE 00148)
00161            3. DISPPRO       (SEE LINE 00154)
00162            3. DISPAQD       (SEE LINE 00150)
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00163            3. DISPABQ
00164               4. OUTCI.
00165            3. DISPACR
00166               4. OUTCI.
00167               4. DISPACL
00168                  5. OUTCI.
00169         2. HALT          (SEE LINE 00009)
00170         2. INIT
00171            3. ENTRYP        (SEE LINE 00011)
00172            3. XTOI.
00173            3. GIMME         (SEE LINE 00112)
00174            3. RITEP         (SEE LINE 00066)
00175            3. SNAP
00176               4. ENTRYP        (SEE LINE 00011)
00177               4. EXITP         (SEE LINE 00033)
00178            3. EXITP         (SEE LINE 00033)
00179         2. LRKPRS
00180            3. SEMANT
00181               4. ENTRYP        (SEE LINE 00011)
00182               4. GOTOER.
00183               4. CODE01
00184                  5. ENTRYP        (SEE LINE 00011)
00185                  5. GIMME         (SEE LINE 00112)
00186                  5. RITEP         (SEE LINE 00066)
00187                  5. EXITP         (SEE LINE 00033)
00188               4. GIMME         (SEE LINE 00112)
00189               4. PACK
00190                  5. ENTRYP        (SEE LINE 00011)
00191                  5. LCMLOC
00192                  5. PAGE          (SEE LINE 00059)
00193                  5. MESAGE        (SEE LINE 00012)
00194                  5. RITEI         (SEE LINE 00015)
00195                  5. TRACE         (SEE LINE 00048)
00196                  5. ROUTER        (SEE LINE 00024)
00197                  5. RITEP         (SEE LINE 00066)
00198                  5. ISDUMP        (SEE LINE 00087)
00199                  5. HALT          (SEE LINE 00009)
00200                  5. EXITP         (SEE LINE 00033)
00201               4. RITEI         (SEE LINE 00015)
00202               4. RITEP         (SEE LINE 00066)
00203               4. LNPLOT        (SEE LINE 00062)
00204               4. CODE03
00205                  5. ENTRYP        (SEE LINE 00011)
00206                  5. SRCHPL
00207                     6. ENTRYP        (SEE LINE 00011)
00208                     6. CREATE
00209                        7. ENTRYP        (SEE LINE 00011)
00210                        7. GIMME         (SEE LINE 00112)
00211                        7. EXITP         (SEE LINE 00033)
00212                     6. EXITP         (SEE LINE 00033)
00213                  5. CREATE        (SEE LINE 00208)
00214                  5. LOADPL
00215                     6. ENTRYP        (SEE LINE 00011)
00216                     6. EXITP         (SEE LINE 00033)
00217                  5. RITEP         (SEE LINE 00066)
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00218              5. LNPLOT      (SEE LINE 00062)
00219              5. ABQUEUE
00220                 6. ENTRYP      (SEE LINE 00011)
00221                 6. GIMME       (SEE LINE 00112)
00222                 6. ADDBLOK     (SEE LINE 00123)
00223                 6. FINDBLK     (SEE LINE 00127)
00224                 6. EXITP       (SEE LINE 00033)
00225              5. ADASASS
00226                 6. ENTRYP      (SEE LINE 00011)
00227                 6. GIMME       (SEE LINE 00112)
00228                 6. FINDBLK     (SEE LINE 00127)
00229                 6. GOTOER.
00230                 6. DELADD
00231                    7. ENTRYP      (SEE LINE 00011)
00232                    7. MESAGE      (SEE LINE 00012)
00233                    7. TRACE       (SEE LINE 00048)
00234                    7. RECER       (SEE LINE 00018)
00235                    7. GIMME       (SEE LINE 00112)
00236                    7. SNAP        (SEE LINE 00175)
00237                    7. LTRMRG
00238                       8. ENTRYP      (SEE LINE 00011)
00239                       8. EXITP       (SEE LINE 00033)
00240                    7. EXITP       (SEE LINE 00033)
00241                 6. ADDBLOK     (SEE LINE 00123)
00242                 6. EXITP       (SEE LINE 00033)
00243              5. EXITP       (SEE LINE 00033)
00244           4. GETHEX
00245              5. ENTRYP      (SEE LINE 00011)
00246              5. HXDGTS
00247                 6. ENTRYP      (SEE LINE 00011)
00248                 6. EXITP       (SEE LINE 00033)
00249              5. MESAGE      (SEE LINE 00012)
00250              5. RITEI       (SEE LINE 00015)
00251              5. GIMME       (SEE LINE 00112)
00252              5. SCHTAB
00253                 6. ENTRYP      (SEE LINE 00011)
00254                 6. EXITP       (SEE LINE 00033)
00255              5. EXITP       (SEE LINE 00033)
00256           4. CODE05
00257              5. ENTRYP      (SEE LINE 00011)
00258              5. SRCHPL      (SEE LINE 00206)
00259              5. FINDBLK     (SEE LINE 00127)
00260              5. GETHEX      (SEE LINE 00244)
00261              5. RITEI       (SEE LINE 00015)
00262              5. RITEP       (SEE LINE 00066)
00263              5. LNPLOT      (SEE LINE 00062)
00264              5. UOLLOAD
00265                 6. ENTRYP      (SEE LINE 00011)
00266                 6. GIMME       (SEE LINE 00112)
00267                 6. ADDBLOK     (SEE LINE 00123)
00268                 6. EXITP       (SEE LINE 00033)
00269              5. ABQUEUE     (SEE LINE 00219)
00270              5. TGTLIST
00271                 6. ENTRYP      (SEE LINE 00011)
00272                 6. FINDBLK     (SEE LINE 00127)
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00273                6. GIMME        (SEE LINE 00112)
00274                6. ADDBLOK      (SEE LINE 00123)
00275                6. PELADD
00276                   7. ENTRYP       (SEE LINE 00011)
00277                   7. GIMME        (SEE LINE 00112)
00278                   7. PTRMRG
00279                   7. EXITP        (SEE LINE 00033)
00280                6. EXITP        (SEE LINE 00033)
00281             5. INITACQ
00282                6. ENTRYP       (SEE LINE 00011)
00283                6. GIMME        (SEE LINE 00112)
00284                6. ADDBLOK      (SEE LINE 00123)
00285                6. ALOG.
00286                6. MESAGE       (SEE LINE 00012)
00287                6. RITEI        (SEE LINE 00015)
00288                6. XTOI.
00289                6. NOWUCIT
00290                   7. ENTRYP       (SEE LINE 00011)
00291                   7. HEXADD
00292                      8. ENTRYP       (SEE LINE 00011)
00293                      8. ITOJ.
00294                      8. EXITP        (SEE LINE 00033)
00295                   7. HEXMULT
00296                      8. ENTRYP       (SEE LINE 00011)
00297                      8. ITOJ.
00298                      8. EXITP        (SEE LINE 00033)
00299                   7. GETHEX       (SEE LINE 00244)
00300                   7. GIMME        (SEE LINE 00112)
00301                   7. ADDBLOK      (SEE LINE 00123)
00302                   7. FINDBLK      (SEE LINE 00127)
00303                   7. DROPBLK
00304                      8. ENTRYP       (SEE LINE 00011)
00305                      8. RELEASE
00306                         9. ENTRYP       (SEE LINE 00011)
00307                         9. MESAGE       (SEE LINE 00012)
00308                         9. RITEI        (SEE LINE 00015)
00309                         9. RITEP        (SEE LINE 00066)
00310                         9. HALT         (SEE LINE 00009)
00311                         9. GIMME        (SEE LINE 00112)
00312                         9. EXITP        (SEE LINE 00033)
00313                      8. EXITP        (SEE LINE 00033)
00314                   7. RELEASE      (SEE LINE 00305)
00315                   7. EXITP        (SEE LINE 00033)
00316                6. EXITP        (SEE LINE 00033)
00317             5. HISTORY
00318                6. ENTRYP       (SEE LINE 00011)
00319                6. MESAGE       (SEE LINE 00012)
00320                6. MASKER
00321                6. TAPE6W
00322                6. OUTCI.
00323                6. EXITP        (SEE LINE 00033)
00324             5. EXITP        (SEE LINE 00033)
00325          4. DMSDEC
00326             5. ENTRYP       (SEE LINE 00011)
00327             5. EXITP        (SEE LINE 00033)
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00328              4. TLL2HX
00329                 5. ENTRYP       (SEE LINE 00011)
00330                 5. SIN.
00331                 5. TAN.
00332                 5. TXY2HX
00333                    6. ENTRYP       (SEE LINE 00011)
00334                    6. EXITP        (SEE LINE 00033)
00335                 5. CENTER
00336                    6. ENTRYP       (SEE LINE 00011)
00337                    6. EXITP        (SEE LINE 00033)
00338                 5. IJ2HX
00339                    6. HEXMLT
00340                       7. HEXADD       (SEE LINE 00291)
00341                       7. ENTRYP       (SEE LINE 00011)
00342                       7. HXDGTS       (SEE LINE 00246)
00343                       7. MESAGE       (SEE LINE 00012)
00344                       7. RITEI        (SEE LINE 00015)
00345                       7. EXITP        (SEE LINE 00033)
00346                    6. ENTRYP       (SEE LINE 00011)
00347                    6. ITOJ.
00348                    6. EXITP        (SEE LINE 00033)
00349                 5. EXITP        (SEE LINE 00033)
00350              4. INPCI.
00351              4. INPCR.
00352              4. TAPE6#
00353              4. OUTCI.
00354              4. OUTCR.
00355              4. ADDBLOK      (SEE LINE 00123)
00356              4. TTIME
00357                 5. ENTRYP       (SEE LINE 00011)
00358                 5. EXITP        (SEE LINE 00033)
00359              4. RITER        (SEE LINE 00044)
00360              4. FINDBLK      (SEE LINE 00127)
00361              4. CODE18
00362                 5. GETHEX       (SEE LINE 00244)
00363                 5. GIMME        (SEE LINE 00112)
00364                 5. PACK         (SEE LINE 00189)
00365                 5. UNPACK
00366                    6. ENTRYP       (SEE LINE 00011)
00367                    6. LCMLOC
00368                    6. RITEP        (SEE LINE 00066)
00369                    6. ISDUMP       (SEE LINE 00087)
00370                    6. HALT         (SEE LINE 00009)
00371                    6. EXITP        (SEE LINE 00033)
00372                 5. UOLLOAD      (SEE LINE 00264)
00373                 5. RITEP        (SEE LINE 00066)
00374                 5. RITEI        (SEE LINE 00015)
00375                 5. LNPLOT       (SEE LINE 00062)
00376                 5. TGTLIST      (SEE LINE 00270)
00377                 5. HISTORY      (SEE LINE 00317)
00378              4. XTOI.
00379              4. SRCHPL       (SEE LINE 00206)
00380              4. EXITP        (SEE LINE 00033)
00381           3. TAPE6#
00382           3. OUTCI.
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00383          3. RDCELL
00384             4. ISHIFT
00385             4. TAPE6#
00386             4. OUTCI.
00387          3. NXTSYM
00388             4. LEXAN
00389                5. CHRGEN
00390                   6. CARD
00391                      7. INPCI.
00392                      7. EOF
00393                      7. TAPE6#
00394                      7. OUTCI.
00395                   6. TAPE6#
00396                   6. OUTCI.
00397                5. ISHIFT
00398                5. GOTOER.
00399                5. ADDCHR
00400                   6. ISHIFT
00401                   6. TAPE6#
00402                   6. OUTCI.
00403                5. LOOKUP
00404                   6. ISHIFT
00405                   6. TAPE6#
00406                   6. OUTCI.
00407                5. EXTSCN
00408                   6. CHRGEN      (SEE LINE 00389)
00409                   6. ITOJ.
00410                5. TAPE6#
00411                5. OUTCI.
00412             4. TAPE6#
00413             4. OUTCI.
00414          3. ERROR
00415             4. TAPE6#
00416             4. OUTCI.
00417          3. ISHIFT
00418          3. APCEL1
00419             4. ISHIFT
00420             4. TAPE6#
00421             4. OUTCI.
00422          3. APCEL2
00423             4. ISHIFT
00424             4. TAPE6#
00425             4. OUTCI.
00426          3. LACELL
00427             4. ISHIFT
00428             4. TAPE6#
00429             4. OUTCI.
00430       2. RELIST
00431          3. ENTRYP      (SEE LINE 00011)
00432          3. RELEASE     (SEE LINE 00305)
00433          3. EXITP       (SEE LINE 00033)
00434       2. DELADD      (SEE LINE 00230)
00435       2. CONTROL
00436          3. ENTRYP      (SEE LINE 00011)
00437          3. LTREE
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00438               4. ENTRYP       (SEE LINE 00011)
00439               4. RELEASE      (SEE LINE 00305)
00440               4. LTRMRG       (SEE LINE 00237)
00441               4. EXITP        (SEE LINE 00033)
00442             3. SELECT
00443               4. ENTRYP       (SEE LINE 00011)
00444               4. GOTDER.
00445               4. MESAGE       (SEE LINE 00012)
00446               4. RITEI        (SEE LINE 00015)
00447               4. HALT         (SEE LINE 00009)
00448               4. FELDEL
00449               4. ASSIGN
00450               4. ATTACK
00451               4. COMMO
00452               4. DOGFITE
00453               4. ENGAGE
00454               4. FLY
00455               4. NAYBOR
00456               4. PERCEPT
00457               4. PLAN
00458                 5. ENTRYP       (SEE LINE 00011)
00459                 5. GETPTRS
00460                   6. ENTRYP       (SEE LINE 00011)
00461                   6. EXITP        (SEE LINE 00033)
00462                 5. THTRPLN
00463                   6. ENTRYP       (SEE LINE 00011)
00464                   6. CORBOUN
00465                     7. ENTRYP       (SEE LINE 00011)
00466                     7. GIMME        (SEE LINE 00112)
00467                     7. THH2PS
00468                       8. ENTRYP       (SEE LINE 00011)
00469                       8. THX2XY
00470                         9. ENTRYP       (SEE LINE 00011)
00471                         9. HXDGTS       (SEE LINE 00246)
00472                         9. JUGGLE
00473                           10. ENTRYP      (SEE LINE 00011)
00474                           10. EXITP       (SEE LINE 00033)
00475                         9. EXITP        (SEE LINE 00033)
00476                       8. EXITP        (SEE LINE 00033)
00477                     7. TXY2HXL
00478                       8. ENTRYP       (SEE LINE 00011)
00479                       8. COS.
00480                       8. SIN.
00481                       8. XTOI.
00482                       8. CENTER       (SEE LINE 00335)
00483                       8. IJ2HX        (SEE LINE 00338)
00484                       8. GETHEX       (SEE LINE 00244)
00485                       8. EXITP        (SEE LINE 00033)
00486                     7. HEXDIST
00487                     7. SIN.
00488                     7. COS.
00489                     7. LINEX
00490                       8. ENTRYP       (SEE LINE 00011)
00491                       8. EXITP        (SEE LINE 00033)
00492                     7. OPTPTH
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00493                    8. ENTRYP      (SEE LINE 00011)
00494                    8. GIMME       (SEE LINE 00112)
00495                    8. THH2PS      (SEE LINE 00467)
00496                    8. HEXCHZ
00497                      9. ENTRYP      (SEE LINE 00011)
00498                      9. TRACE       (SEE LINE 00048)
00499                      9. MESAGE      (SEE LINE 00012)
00500                      9. RITEP       (SEE LINE 00066)
00501                      9. CLOST       (SEE LINE 00058)
00502                      9. HEXADD      (SEE LINE 00291)
00503                      9. HEXINV
00504                        10. ENTRYP      (SEE LINE 00011)
00505                        10. ITOJ.
00506                        10. EXITP       (SEE LINE 00033)
00507                      9. GETHEX      (SEE LINE 00244)
00508                      9. EXITP       (SEE LINE 00033)
00509                    8. LINEX       (SEE LINE 00489)
00510                    8. EXITP       (SEE LINE 00033)
00511                  7. EXITP       (SEE LINE 00033)
00512                6. REVISE
00513                  7. ENTRYP      (SEE LINE 00011)
00514                  7. GIMME       (SEE LINE 00112)
00515                  7. ABVSCOR
00516                    8. ENTRYP      (SEE LINE 00011)
00517                    8. CLOSCOR
00518                      9. ENTRYP      (SEE LINE 00011)
00519                      9. HEXDIST
00520                      9. EXITP       (SEE LINE 00033)
00521                    8. GIMME       (SEE LINE 00112)
00522                    8. ADJBLOK     (SEE LINE 00123)
00523                    8. EXITP       (SEE LINE 00033)
00524                  7. RELEASE     (SEE LINE 00305)
00525                  7. EXITP       (SEE LINE 00033)
00526                6. FINDBLK     (SEE LINE 00127)
00527                6. KOMPARE
00528                  7. ENTRYP      (SEE LINE 00011)
00529                  7. UNPACK      (SEE LINE 00365)
00530                  7. PACK        (SEE LINE 00189)
00531                  7. EXITP       (SEE LINE 00033)
00532                6. CANDTGT
00533                  7. ENTRYP      (SEE LINE 00011)
00534                  7. FINDBLK     (SEE LINE 00127)
00535                  7. CLOSCOR     (SEE LINE 00517)
00536                  7. JGESJIT
00537                    8. ENTRYP      (SEE LINE 00011)
00538                    8. THX2XY      (SEE LINE 00469)
00539                    8. ATAN2.
00540                    8. EXITP       (SEE LINE 00033)
00541                  7. FORMTGT
00542                    8. ENTRYP      (SEE LINE 00011)
00543                    8. GIMME       (SEE LINE 00112)
00544                    8. FINDBLK     (SEE LINE 00127)
00545                    8. FINDFLT
00546                      9. ENTRYP      (SEE LINE 00011)
00547                      9. HEXDIST
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00548                        9. FINDBLK      (SEE LINE 00127)
00549                        9. KOMPARE      (SEE LINE 00527)
00550                        9. GIMME        (SEE LINE 00112)
00551                        9. ADDBLOK      (SEE LINE 00123)
00552                        9. EXITP        (SEE LINE 00033)
00553                     8. RELEASE      (SEE LINE 00305)
00554                     8. EXITP        (SEE LINE 00033)
00555                  7. GIMME        (SEE LINE 00112)
00556                  7. ADDBLOK      (SEE LINE 00123)
00557                  7. TGTGONE
00558                     8. ENTRYP       (SEE LINE 00011)
00559                     8. PTREE
00560                        9. ENTRYP       (SEE LINE 00011)
00561                        9. RELEASE      (SEE LINE 00305)
00562                        9. ISHIFT
00563                        9. EXITP        (SEE LINE 00033)
00564                     8. GIMME        (SEE LINE 00112)
00565                     8. EXITP        (SEE LINE 00033)
00566                  7. PTREE        (SEE LINE 00559)
00567                  7. RANDOM.
00568                  7. RELADD       (SEE LINE 00275)
00569                  7. EXITP        (SEE LINE 00033)
00570               6. ITRAP        (SEE LINE 00028)
00571               6. AVAILBL
00572                  7. ENTRYP       (SEE LINE 00011)
00573                  7. RELADD       (SEE LINE 00275)
00574                  7. RELEASE      (SEE LINE 00305)
00575                  7. EXITP        (SEE LINE 00033)
00576               6. SCHEDUL
00577                  7. ENTRYP       (SEE LINE 00011)
00578                  7. UNPACK       (SEE LINE 00365)
00579                  7. RANDOM.
00580                  7. RENDEVU
00581                     8. ENTRYP       (SEE LINE 00011)
00582                     8. THX2XY       (SEE LINE 00469)
00583                     8. TXY2HXL      (SEE LINE 00477)
00584                     8. EXITP        (SEE LINE 00033)
00585                  7. HEXADD       (SEE LINE 00291)
00586                  7. GETHEX       (SEE LINE 00244)
00587                  7. HEXDIST
00588                  7. ACFRAG
00589                     8. ENTRYP       (SEE LINE 00011)
00590                     8. GIMME        (SEE LINE 00112)
00591                     8. CRFLTML
00592                        9. ENTRYP       (SEE LINE 00011)
00593                        9. CREATE       (SEE LINE 00208)
00594                        9. GIMME        (SEE LINE 00112)
00595                        9. ADDBLOK      (SEE LINE 00123)
00596                        9. HISTORY      (SEE LINE 00317)
00597                        9. EXITP        (SEE LINE 00033)
00598                     8. ADDBLOK      (SEE LINE 00123)
00599                     8. OPTPTH       (SEE LINE 00492)
00600                     8. RELEASE      (SEE LINE 00305)
00601                     8. FLTGEOM
00602                        9. ENTRYP       (SEE LINE 00011)
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00603                         9. HEXCHZ       (SEE LINE 00496)
00604                         9. THH2PS       (SEE LINE 00467)
00605                         9. ATAN2.
00606                         9. EXITP        (SEE LINE 00033)
00607                       8. HEXDIST
00608                       8. DELADD       (SEE LINE 00230)
00609                       8. EXITP        (SEE LINE 00033)
00610                     7. EXITP        (SEE LINE 00033)
00611                   6. DELADD       (SEE LINE 00230)
00612                   6. PLANOUT
00613                     7. ENTRYP       (SEE LINE 00011)
00614                     7. OUTCI.
00615                     7. EXITP        (SEE LINE 00033)
00616                   6. RLRAID
00617                     7. ENTRYP       (SEE LINE 00011)
00618                     7. RLWAVE
00619                       8. ENTRYP       (SEE LINE 00011)
00620                       8. RLTGTYP
00621                         9. ENTRYP       (SEE LINE 00011)
00622                         9. RELEASE      (SEE LINE 00305)
00623                         9. RLTGTAK
00624                           10. ENTRYP      (SEE LINE 00011)
00625                           10. RLFMAKT
00626                             11. ENTRYP      (SEE LINE 00011)
00627                             11. RELEASE     (SEE LINE 00305)
00628                             11. EXITP       (SEE LINE 00033)
00629                           10. RELEASE     (SEE LINE 00305)
00630                           10. EXITP       (SEE LINE 00033)
00631                         9. EXITP        (SEE LINE 00033)
00632                       8. RELEASE      (SEE LINE 00305)
00633                       8. EXITP        (SEE LINE 00033)
00634                     7. RLCORD
00635                       8. ENTRYP       (SEE LINE 00011)
00636                       8. RLAB3B
00637                         9. ENTRYP       (SEE LINE 00011)
00638                         9. RELEASE      (SEE LINE 00305)
00639                         9. EXITP        (SEE LINE 00033)
00640                       8. RELEASE      (SEE LINE 00305)
00641                       8. EXITP        (SEE LINE 00033)
00642                     7. RELEASE      (SEE LINE 00305)
00643                     7. EXITP        (SEE LINE 00033)
00644                   6. EXITP        (SEE LINE 00033)
00645                 5. EXITP        (SEE LINE 00033)
00646               4. PONDER
00647               4. TOWER
00648               4. UMPIRE
00649               4. TAPE6#
00650               4. OUTCI.
00651               4. OUTCR.
00652               4. EXITP        (SEE LINE 00033)
00653             3. SNAP         (SEE LINE 00175)
00654             3. UNSNAP
00655               4. ENTRYP       (SEE LINE 00011)
00656               4. EXITP        (SEE LINE 00033)
00657             3. RELEASE      (SEE LINE 00305)
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          3. SECOND
          3. HLTPNT
             4. ENTRYP        (SEE LINE 00011)
             4. SECOND
             4. HALT          (SEE LINE 00009)
             4. EXITP         (SEE LINE 00033)
          3. EXITP        (SEE LINE 00033)
       2. EXITP       (SEE LINE 00033)
       2. END.
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2. Main Processor

LIST OF SUBROUTINES - WADEM

1. ABSEE
2. ABVSCOR
3. AB2CRC
4. ACCEPT
5. ACFRAG
6. ADDBLOK
7. ADUMP
8. AIRTHNK
9. ALLOBAT
10. ALLOFU
11. ALLOPAT
12. AMMOCHK
13. ASSIGN
14. ATKASES
15. ATTACK
16. AUTOPRI
17. AVAILBL
18. AZILIM
19. BADMOVE
20. BATCEAS
21. BATTCOV
22. BATTOUT
23. BLKDAT
24. BNCMOPR
25. BNCONHD
26. BNCONLS
27. BNCONTC
28. BNLALLE
29. BNNOTRD
30. BNNWTRK
31. BNPONBB
32. BNPONBD
33. BNPONDA
34. BNPONEP
35. BNPONFA
36. BNPONFD
37. BNPONSS
38. BNRECOV
39. BOCTINK
40. BTNASIN
41. BTN2CRC
42. BTRYTNK
43. BYALCOV
44. BYCMOPR
45. BYCONHD
46. BYCONLS
47. BYCONTC
48. BYENDPS
49. BYHEDUP
50. BYNOTRD
51. BYNWTRK
52. BYPASUP

53. BYPONER
54. BYPONFO
55. BYPONRL
56. BYPONRS
57. BYPONTM
58. BYTKCHK
59. BYUPDAT
60. CANCALO
61. CANDTGT
62. CENTER
63. CFLYCRC
64. CHKCOV
65. CHKLAST
66. CLIST
67. CLIST2
68. CLOSCOR
69. CNACTTK
70. COMMAND
71. COMMO
72. CONTROL
73. CORBOUN
74. COVAPLY
75. CRCDIES
76. CRCEVNT
77. CRCKIL
78. CRCLOSS
79. CRCSEE
80. CRCTHNK
81. CRCTRAK
82. CRC2INT
83. CREATE
84. CRFLTML
85. DBGREAD
86. DECRALO
87. DELADD
88. DESTROY
89. DETECT
90. DGTSHX
91. DILOUT
92. DISPABQ
93. DISPACD
94. DISPACL
95. DISPACR
96. DISPADS
97. DISPAQD
98. DISPDAT
99. DISPFDB
100. DISPFLT
101. DISPFMF
102. DISPPAF
103. DISPPAY
104. DISPPRO
105. DISPPYB
106. DLYACT
107. DOGFITE

108. DOGTHNK
109. DROPBLK
110. DROPPOS
111. DROPPS2
112. ENGAGE
113. ENTRYP
114. ENTSTAT
115. EOF
116. EXITP
117. FELDEL
118. FETCH
119. FILERUP
120. FINDBLK
121. FINDFLT
122. FINDIT
123. FIRECHK
124. FLITE
125. FLTGEOM
126. FLTWYPE
127. FLY
128. FLYSEE
129. FORMTGT
130. FSDUMP
131. FSINIT
132. FUELCHK
133. GETHEX
134. GETPTRS
135. GIMME
136. GNOLOOK
137. GOGETEM
138. GOTOAB
139. HALT
140. HANDZPT
141. HEXADD
142. HEXCHZ
143. HEXDIST
144. HEXINV
145. HEXMLT
146. HEXMOVE
147. HEXMULT
148. HISTORY
149. HLTPNT
150. HOLD
151. HXDGTS
152. HXMLT2
153. ICHECK
154. IJ2HX
155. INIT
156. INITACQ
157. INRANGE
158. INSECT
159. INSERT
160. INTASIN
161. INTFIND
162. INTRFLY

163. INT2CRC
164. IPJL
165. ISDUMP
166. ISHIFT
167. ITRAP
168. JGESUIT
169. JTJ
170. JUGGLE
171. KILFLIT
172. KOMPARE
173. LCMLOC
174. LINEX
175. LNPLOT
176. LOADPL
177. LOSRADR
178. LRKPRS
179. LTREE
180. LTRMRG
181. MADEM
182. MASKER
183. MESAGE
184. MESBILD
185. NAYBOR
186. NEWMOVE
187. NEWPERC
188. NOWUCIT
189. NUKBLND
190. OPTPTH
191. OTHRDAT
192. OUTA
193. OUTPTRS
194. PACK
195. PAGE
196. PATDEC
197. PELADD
198. PERCEPT
199. PLAN
200. PLANOUT
201. PONDER
202. PREPAFU
203. PRIORTY
204. PTPONER
205. PTRAND
206. PTREE
207. PTRMRG
208. READIL
209. RECCON
210. RECER
211. RECOVR
212. REDERRF
213. RELEASE
214. RELIST
215. RELOAD
216. RELOCAT
217. RELSTILL

273. UNLINK
274. UNPACK
275. UNSNAP
276. UNSTAT
277. UOLLJAO
278. WIPEOUT
279. WTHDRAW
280. XPAA
281. XPD
282. XPK
283. XSHIFT
284. XY2HX
285. YANK

LIST OF FORTRAN LIBRARY ROUTINES - MADEM

1. ALOG.
2. ASIN.
3. ATAN2.
4. COS.
5. DECODI.
6. ENDFIL.
7. END.
8. GOTOER.
9. INPBI.
10. INPCI.
11. INPFI.
12. ITOJ.
13. OUTBI.
14. OUTCI.
15. OUTCR.
16. QINTRY.
17. RANDOM.
18. REWIND.
19. SIN.
20. SQRT.
21. STOP.
22. TAN.
23. TAPE6#
24. XTOI.

218. RENDEVU
219. RESUPLY
220. REVISE
221. RITEI
222. RITEP
223. RITER
224. RLABOB
225. RLCORD
226. RLFMAKT
227. RLRAIO
228. RLTGTAK
229. RLTGTYP
230. RLWAVE
231. RONDSEE
232. ROUTER
233. SAMATON
234. SAMPRCM
235. SAMSEE
236. SAMWYPE
237. SCHEDUL
238. SCHTAB
239. SDIGEST
240. SECOND
241. SEEKENG
242. SEEKP
243. SEEKTAC
244. SEEKTFU
245. SELECT
246. SETASSN
247. SHRKILL
248. SHUFFLE
249. SKSBTRK
250. SNAP
251. SSLL
252. STATPAK
253. STICK
254. TERMACQ
255. TFLYCRC
256. TGTGONE
257. TGTHEX
258. THH2PS
259. THTRPLN
260. THX2XY
261. TH2HX
262. TOADIL
263. TOWER
264. TRACE
265. TRKCHEK
266. TRPRMT
267. TRPRNT
268. TRPRRT
269. TRYSHOT
270. TXY2HX
271. TXY2HXL
272. UMPIRE

SUBROUTINE REFERENCE LIST - MADEM

1. ABSEE	CALLS: UNPACK DELADD RELEASE TAPE6# OUTCI.	CALLED BY: PERCEPT
2. ABVSCOR	CALLS: ENTRYP CLOSCOR GIMME ADDBLOK EXITP	CALLED BY: REVISE
3. AB2CRC	CALLS: UNPACK RELEASE FINDBLK GIMME ADDBLOK TAPE6# OUTCI. DROPBLK	CALLED BY: CRCTHNK
4. ACCEPT	CALLS: UNPACK SEEKP GIMME STOP. STICK DETECT DELADD PACK TAPE6# OUTCI. BYALCOV RELEASE BYHEDUP OUTA	CALLED BY: BYCMDPR BNCMDPR
5. ACFRAG	CALLS: GIMME UNPACK CRFLTML ADDBLOK OPTPTH RELEASE PACK FLTGEOM HEXDIST DELADD	CALLED BY: SCHEDUL

6. ADDBLOK	CALLS: ENTRYP, EXITP	CALLED BY: UDLLOAD, REDEBRF, NOWUCIT, NEWMOVE, INT2CRC, INITACQ, GOGETEM, FLYSEE, FINDIT, FINDFLT, CRFLTML, CANDTGT, BADMOVE, ATKASES, ACFRAG, ABVSCOR, AB2CRC
7. ADUMP	CALLS: OUTCI., OUTCR.	CALLED BY: HALT, RECCON
8. AIRTHNK	CALLS: HEXDIST, MESBILD, DELADD, TGTHEX, TAPE6#, OUTCI., RANDOM.	CALLED BY: TFLYCRC
9. ALLOBAT	CALLS: PRIORTY, MESBILD, GIMME, PACK, TAPE6#, OUTCI., OUTA, DELADD, YANK, STICK, TOADIL	CALLED BY: SEEKTAC, SEEKENG, BOCTINK
10. ALLOFU	CALLS: GIMME, STICK, DELADD, TAPE6#, OUTCI.	CALLED BY: SEEKTFU, BATTCOV
11. ALLOPAT	CALLS: GIMME	CALLED BY: SEEKTFU

	STICK DELADD TAPE6# OUTCI.	BATTCOV
12. AMMOCHK	CALLS: MESBILD DELADD GOTOER. BYNOTRD TAPE6# OUTCI.	CALLED BY: ENGAGE
13. ASSIGN	CALLS: GETPTRS INTASIN	CALLED BY: SELECT
14. ATKASES	CALLS: GIMME DELADD DESTROY TAPE6# OUTCI. ADDBLOK THH2PS ATAN2.	CALLED BY: CFLYCRC
15. ATTACK	CALLS: GETPTRS UNSTAT SHRKILL FINDBLK XPK RANDOM. NUKBLND DROPBLK HISTORY DELADD STATPAK	CALLED BY: SELECT
16. AUTOPRI		CALLED BY: SAMATON PREPAFU BYCONHD
17. AVAILBL	CALLS: DELADD RELEASE	CALLED BY: THTRPLN
18. AZILIM	CALLS: SIN. COS. INSECT SQRT.	CALLED BY: INRANGE

19. BADMOVE	CALLS:	CALLED BY:
	FINDBLK	CRCTRAK
	GIMME	
	ADDBLOK	
	HISTORY	
	UNPACK	
	RELEASE	
	DROPBLK	
	TGTHEX	
	HEXDIST	
	MESBILD	
	DELADD	
20. BATCEAS	CALLS:	CALLED BY:
	CANCALO	TRYSHOT
	GIMME	HANDZPT
	UNPACK	BYCONTC
	SEEKTFU	BYPONFO
	STICK	BYNOTRD
	RELEASE	BYCONLS
		BYCMOPR
		BTRYTNK
21. BATTCOV	CALLS:	CALLED BY:
	TRKCHEK	BYALCOV
	ALLOFU	BYCONTC
	ALLOPAT	BYPONER
		BYNWTRK
		BYHEDUP
		BYCONHO
22. BATTOUT	CALLS:	CALLED BY:
	YANK	BYUPDAT
	BNLALLE	BNPONBO
	UNPACK	
	CHKLAST	
	GIMME	
	RELEASE	
	SSLL	
23. BLKDAT		
24. BNCMOPR	CALLS:	CALLED BY:
	GOTOER.	BOCTINK
	ACCEPT	
	MESBILD	
	DELADD	
	SEEKP	
	DROPPOS	
	DILOUT	
25. BNCONHO	CALLS:	CALLED BY:
	TAPE6#	BNCONTC
	OUTCI.	

	GIMME	
	MESBILD	
	PRIORTY	
	PACK	
	DELADD	
	YANK	
	STICK	
	RELEASE	
	DROPPOS	
	SEEKTAC	
	DLYACT	
26. BNCONLS	CALLS:	CALLED BY:
	DROPPOS	SDIGEST
	DILOUT	
	MESBILD	
	DELADD	
27. BNCONTC	CALLS:	CALLED BY:
	CHKCOV	SDIGEST
	DROPPOS	BNPONDA
	BNLALLE	
	SETASSN	
	SEEKTAC	
	GIMME	
	DLYACT	
	CHKLAST	
	BNCONHD	
	BNRECOV	
	TAPE6#	
	OUTCI.	
	YANK	
	STICK	
	TOADIL	
	DILOUT	
28. BNLALLE	CALLS:	CALLED BY:
	MESBILD	TRYSHOT
	DELADD	SDIGEST
	YANK	TRKCHEK
	HANDZPT	SAMPRCM
	DILOUT	BYCONTC
	STICK	BNCONTC
		BYNWTRK
		BYENDPS
		BYCONLS
		BTRYTNK
		BOCTINK
		BNPONEP
		BNPONDA
		BNNWTRK
		BATTOUT
29. BNNOTRO	CALLS:	CALLED BY:
	TAPE6#	BYUPDAT

		OUTCI.	BNPONBD
		RELEASE	
		DILOUT	
30. BNNWTRK	CALLS:		CALLED BY:
		CHKCOV	SDIGEST
		BNLALLE	
		SETASSN	
		SEEKTAC	
		GIMME	
		DLYACT	
31. BNPONBB	CALLS:		CALLED BY:
		FILERUP	BNPONSS
		UNPACK	
		INRANGE	
		GIMME	
		DELADD	
		SETASSN	
		SEEKENG	
		PRIORTY	
		RELOCAT	
		STICK	
		GOTOER.	
		DLYACT	
		TAPE6#	
		OUTCI.	
32. BNPONBD	CALLS:		CALLED BY:
		TAPE6#	BOCTINK
		OUTCI.	
		BNNOTRD	
		BATTOUT	
		COVAPLY	
		RELEASE	
33. BNPONDA	CALLS:		CALLED BY:
		YANK	BOCTINK
		UNPACK	
		GOTOER.	
		SETASSN	
		SEEKTAC	
		CHKCOV	
		BNLALLE	
		GIMME	
		DLYACT	
		BNCONTC	
		SEEKENG	
		RELEASE	
34. BNPONEP	CALLS:		CALLED BY:
		GOTOER.	BOCTINK
		SKSBTRK	
		DROPPOS	
		BNLALLE	

```
                         UNPACK
                         CHKLAST
                         SEEKTAC
                         GIMME
                         PACK
                         DLYACT
                         SEEKENG
                         MESBILD
                         DELADD
                         YANK
                         STICK
                         READIL
35. BNPONFA          CALLS:                      CALLED BY:
                         SEEKP                             BOCTINK
                         TAPE6#
                         OUTCI.
                         BNRECOV
36. BNPONFD          CALLS:                      CALLED BY:
                         SEEKP                             BOCTINK
                         TAPE6#
                         OUTCI.
                         RELEASE
                         YANK
                         DROPPOS
                         DILOUT
                         MESBILD
                         DELADD
37. BNPONSS          CALLS:                      CALLED BY:
                         UNPACK                            BOCTINK
                         GOTOER.
                         BNPONBR
                         SEEKENG
                         GIMME
                         DLYACT
                         BYUPDAT
38. BNRECOV          CALLS:                      CALLED BY:
                         UNPACK                            BNCONTC
                         WTHDRAW                           BNPONFA
                         PACK
39. BOCTINK          CALLS:                      CALLED BY:
                         BNPONSS                           PONDER
                         BNPONEP
                         BNCMDPR
                         BNPONFA
                         BNPONFD
                         RELEASE
                         SDIGEST
                         BNPONDA
                         TAPE6#
                         OUTCI.
```

	DROPPOS BNLALLE MESBILD DELADD DILOUT BNPONBD SAMATON ALLOBAT	
40. BTNASIN	CALLS: UNPACK FINDBLK PACK HEXDIST RELEASE DROPBLK MESBILD DELADD TAPE6# OUTCI.	CALLED BY: INTASIN
41. BTN2CRC	CALLS: UNPACK RELEASE TAPE6# OUTCI. CRCLOSS CRCKIL CRCTRAK	CALLED BY: CRCTHNK
42. BTRYTNK	CALLS: BYCMOPR SDIGEST SEEKP BYPONTM BYPONER TAPE6# OUTCI. YANK BATCEAS BNLALLE MESBILD DELADD BYPONFD SAMATON BYPONRL BYPONRS	CALLED BY: PONDER
43. BYALCOV	CALLS: UNPACK PACK GIMME SSLL CANCALO SEEKTFU	CALLED BY: BYCONTC BYCMDPR ACCEPT

```
                             RELEASE
                             PATDEC
                             BATTCOV
                             DLYACT
                             TAPE6#
                             OUTCI.
44. BYCMOPR            CALLS:                        CALLED BY:
                             ACCEPT                              BTRYTNK
                             SEEKP
                             TAPE6#
                             OUTCI.
                             BATCEAS
                             DILOUT
                             BYALCOV
                             BYHEDUP
                             RELEASE
45. BYCONHD            CALLS:                        CALLED BY:
                             TAPE6#                              BYCONTC
                             OUTCI.
                             DELADD
                             AUTOPRI
                             STICK
                             RELOCAT
                             BATTCOV
                             GIMME
                             DLYACT
46. BYCONLS            CALLS:                        CALLED BY:
                             BATCEAS                             SDIGEST
                             BNLALLE
                             MESBILD
                             DELADD
                             DILOUT
47. BYCONTC            CALLS:                        CALLED BY:
                             MESBILD                             SDIGEST
                             DELADD                              BYPONTM
                             INRANGE
                             BATCEAS
                             BNLALLE
                             PREPAFU
                             BATTCOV
                             GIMME
                             DLYACT
                             BYCONHD
                             UNPACK
                             BYALCOV
                             STICK
                             RELOCAT
                             YANK
                             TOADIL
48. BYENDPS            CALLS:                        CALLED BY:
```

		CALLS:	CALLED BY:
		SEEKP	SAMWYPE
		UNPACK	SAMPRCM
		YANK	BYPONFO
		RELEASE	
		GETPTRS	
		CRCLOSS	
		BNLALLE	
49.	BYHEDUP	SEEKP	BYCHOPR
		UNPACK	ACCEPT
		DELADD	
		RELOCAT	
		BATTCOV	
		MESBILD	
		RELEASE	
50.	BYNOTRD	UNPACK	AMMOCHK
		BATCEAS	
		DILOUT	
		TAPE6#	
		OUTCI.	
51.	BYNWTRK	MESBILD	SDIGEST
		DELADD	
		BNLALLE	
		INRANGE	
		PREPAFU	
		BATTCOV	
		GIMME	
		DLYACT	
		STICK	
		RELOCAT	
52.	BYPASUP	SEEKP	SAMPRCM
		UNPACK	
		GIMME	
		PACK	
		NEWPERC	
		GETPTRS	
		CRCTRAK	
53.	BYPONER	UNPACK	BTRYTNK
		CANCALO	
		SEEKTFU	
		BATTCOV	
		DILOUT	
		PACK	
		DELADD	
		PTPONER	
		MESBILD	

```
                           RELEASE
54. BYPONFD             CALLS:                      CALLED BY:
                           SEEKP                               BTRYTNK
                           YANK
                           RELEASE
                           BATCEAS
                           DILOUT
                           BYENDPS
                           MESBILD
                           DELADD
55. BYPONRL             CALLS:                      CALLED BY:
                           UNPACK                              BTRYTNK
                           GOTOER.
                           FILERUP
                           INRANGE
                           PREPAFU
                           MESBILD
                           DELADD
                           SEEKTFU
                           TAPE6#
                           OUTCI.
56. BYPONRS             CALLS:                      CALLED BY:
                           UNPACK                              BTRYTNK
                           RELOAD
                           TAPE6#
                           OUTCI.
                           RELEASE
57. BYPONTM             CALLS:                      CALLED BY:
                           GIMME                               BTRYTNK
                           UNPACK
                           PACK
                           TAPE6#
                           OUTCI.
                           BYCONTC
                           TRYSHOT
                           DELADD
                           RELEASE
58. BYTKCHK             CALLS:                      CALLED BY:
                           SQRT.                               SAMPRCM
                           ATAN2.
                           LOSRADR
                           DELADD
                           YANK
                           STICK
                           TOADIL
59. BYUPDAT             CALLS:                      CALLED BY:
                           UNPACK                              BNPONSS
                           BNNOTRD
                           BATTOUT
```

	CALLS:	CALLED BY:
	COVAPLY	
	GIMME	
	PACK	
	SSLL	
	DECRALO	
	SEEKTAC	
	DLYACT	
	RELEASE	
60. CANCALO	CALLS:	CALLED BY:
	YANK	PTPONER
	RELEASF	BYALCOV
	TAPE6#	PATDEC
	OUTCI.	BYPONER
	READIL	BATCEAS
61. CANDTGT	CALLS:	CALLED BY:
	ENTRYP	THTRPLN
	FINDBLK	
	CLOSCOR	
	JGESUIT	
	FORMTGT	
	GIMME	
	ADDBLOK	
	TGTGONE	
	PTREE	
	RANDOM.	
	PELADD	
	EXITP	
62. CENTER	CALLS:	CALLED BY:
	ENTRYP	XY2HX
	EXITP	TXY2HXL
63. CFLYCRC	CALLS:	CALLED BY:
	CRCSEE	PERCEPT
	UNSTAT	
	FLYSEE	
	ATKASES	
	CRC2INT	
	RONDSEE	
	GNDLOOK	
	STATPAK	
64. CHKCOV	CALLS:	CALLED BY:
	UNPACK	BNCONTC
	INRANGE	BNPONDA
	GIMME	BNNWTRK
	TAPE6#	
	OUTCI.	
	OUTA	
	DELADD	
65. CHKLAST	CALLS:	CALLED BY:
	DROPPOS	BNCONTC

AD-A107 916 BDM CORP MCLEAN VA F/G 15/3

MODULAR AIR DEFENSE EFFECTIVENESS MODEL, PROGRAM DOCUMENTATION --ETC(U)

JAN 80 M FILTEAU, B MACALEER, J T HAWKINS DNA001-79-C-0230

UNCLASSIFIED BDM/W-79-646-TR-VOL-2 DNA-5594F-2 NL

5 of 6

AD
A107916

	CALLS:	CALLED BY:
	PRIORTY RELOCAT DELADD	BNPONEP BATTOUT
66. CLIST	PAGE LNPLOT MESAGE RITEP RITER RITEI TAPE6# OUTCI. OUTCR. CLIST2	HALT UNSTAT TGTHEX TRKCHEK SAMPRCM NAYBOR HEXMOVE HEXCHZ FSDUMP FLTWYPE FINDBLK CRCDIES INTASIN
67. CLIST2	PAGE LNPLOT MESAGE RITEI RITER TAPE6# OUTCI. OUTCR. RITEP	CLIST
68. CLOSCOR	ENTRYP HEXDIST EXITP	CANDTGT ABVSCOR
69. CNACTTK	YANK RELEASE	DILOUT
70. COMMAND	UNPACK GOTOER. DELADD TAPE6# OUTCI. MESBILD FLTWYPE THH2PS ATAN2.	FLITE
71. COMMO	UNPACK DELADD RELEASE PACK	SELECT

72. CONTROL	CALLS: ENTRYP, LTREE, SELECT, SNAP, UNSNAP, RELEASE, SECOND, HLTPNT, EXITP	CALLED BY: MADEM
73. CORBOUN	CALLS: ENTRYP, GIMME, THH2PS, TXY2HXL, HEXDIST, SIN., COS., LINEX, OPTPTH, EXITP	CALLED BY: THTRPLN
74. COVAPLY	CALLS: SEEKTAC, GIMME, DLYACT, RELEASE	CALLED BY: BYUPDAT, BNPONBO
75. CRCDIES	CALLS: UNPACK, RELEASE, DELADD, FINDBLK, TRACE, MESAGE, RITEI, CLIST, DROPBLK	CALLED BY: DESTROY
76. CRCEVNT	CALLS: GIMME, TAPE6#, OUTCI., DELADD, RELEASE, FINDBLK, DETECT, UNPACK, HEXDIST, LOSRADR, COS., RANDOM., CRCTRAK	CALLED BY: CRCSEE

	CALLS:	CALLED BY:
77. CRCKIL	FINDBLK UNPACK RELEASE DROPBLK TAPE6# OUTCI. DELADD	INT2CRC CRCTRAK CRCTHNK BTN2CRC
78. CRCLOSS	FINDBLK UNPACK DROPBLK DELADD	SAMPRCM CRCTHNK BYENDPS BTN2CRC
79. CRCSEE	RELEASE GIMME UNPACK DELADD CRCEVNT	CFLYCRC
80. CRCTHNK	UNPACK RELEASE CRCKIL CRCTRAK CRCLOSS AB2CRC INT2CRC BTN2CRC	TFLYCRC
81. CRCTRAK	FINDBLK UNPACK MESBILD DELADD TAPE6# OUTCI. CRCKIL BADMOVE DROPBLK RANDOM. NEWMOVE	SAMPRCM CRCTHNK CRCEVNT BYPASUP BTN2CRC
82. CRC2INT	UNPACK TAPE6# OUTCI. MESBILD DELADD OPTPTH RELEASE THH2PS	CFLYCRC

		ATAN2.		
83. CREATE	CALLS:	ENTRYP	CALLED BY:	CRFLTML
		GIMME		
		EXITP		
84. CRFLTML	CALLS:	CREATE	CALLED BY:	GOGETEM
		GIMME		ACFRAG
		UNPACK		
		PACK		
		ADDBLOK		
		HISTORY		
85. DBGREAD	CALLS:	OUTCI.	CALLED BY:	MADEM
		INPCI.		
		EOF		
		DECODI.		
86. DECRALO	CALLS:	MESBILD	CALLED BY:	WTHDRAW
		DELADD		BYUPDAT
		TAPE6#		
		OUTCI.		
87. DELADD	CALLS:	ENTRYP	CALLED BY:	UMPIRE
		MESAGE		TOWER
		TRACE		THTRPLN
		RECER		SHRKILL
		GIMME		SETASSN
		SNAP		SEEKTAC
		LTRMRG		SEEKENG
		EXITP		SDIGEST
				SAMWYPE
				SAMSEE
				SAMATON
				RESUPLY
				RELOAD
				READIL
				PTPONER
				PREPAFU
				NUKBLND
				NEWPERC
				NEWMOVE
				BYTKCHK
				BYCONTC
				BNLALLE
				NAYBOR
				KILFLIT
				INTRFLY
				INTZCRC
				INTFIND

```
CRC2INT
GOGETEM
GNDLOOK
FUELCHK
FLYSEE
FLY
FLITE
FILERUP
ENGAGE
DROPPS2
DROPPOS
DOGTHNK
DOGFITE
DESTROY
DECRALO
CRCTRAK
CRCSEE
CRCLOSS
CRCKIL
CRCEVNT
CRCDIES
COMMO
COMMAND
CHKLAST
CHKCOV
BYPONTM
BYPONRL
BYPONFD
BYPONER
BYNWTRK
BYHEDUP
BYCONLS
BYCONHO
BTRYTNK
BTNASIN
BOCTINK
BNPONFD
BNPONEP
BNPONBB
BNCONLS
BNCONHO
BNCMDPR
BADMOVE
INTASIN
ATTACK
ATKASES
AMMOCHK
ALLOPAT
ALLOFU
ALLOBAT
AIRTHNK
ACFRAG
ACCEPT
ABSEE
MADEM
```

```
88. DESTROY          CALLS:                      CALLED BY:
                           TAPE6#                           UMPIRE
                           OUTCI.                           TOWER
                           GETPTRS                          SHRKILL
                           TERMACQ                          REDEBRF
                           KILFLIT                          FLY
                           GIMME                            DOGFITE
                           DELADD                           ATKASES
                           SAMWYPE
                           CRCDIES
                           UNLINK
                           RELEASE
                           UNSTAT

89. DETECT           CALLS:                      CALLED BY:
                           HEXDIST                          SAMPRCM
                           UNPACK                           INT2CRC
                           THH2PS                           FLYSEE
                           ATAN2.                           CRCEVNT
                           LOSRADR                          ACCEPT
                           COS.
                           RANDOM.
                           TAPE6#
                           OUTCI.

90. DGTSHX           CALLS:
                           ITOJ.

91. DILOUT           CALLS:                      CALLED BY:
                           CNACTTK                          SAMATON
                           RELEASE                          PTPONER
                           UNPACK                           HANDZPT
                           YANK                             BNLALLE
                           TOADIL                           BNCONTC
                                                            BYPONFD
                                                            BYPONER
                                                            BYNOTRD
                                                            BYCONLS
                                                            BYCMDPR
                                                            BOCTINK
                                                            BNPONFD
                                                            BNNOTRD
                                                            BNCONLS
                                                            BNCMDPR

92. DISPABQ          CALLS:                      CALLED BY:
                           OUTCI.                           DISPDAT

93. DISPACD          CALLS:                      CALLED BY:
                           OUTCI.                           DISPFLT
                                                            DISPDAT

94. DISPACL          CALLS:                      CALLED BY:
                           OUTCI.                           DISPACR
```

95. DISPACR	CALLS: OUTCI. DISPACL	CALLED BY: DISPDAT
96. DISPADS	CALLS: OUTCI.	CALLED BY: DISPDAT
97. DISPAQD	CALLS: OUTCI.	CALLED BY: DISPFLT DISPDAT
98. DISPDAT	CALLS: OUTCI. DISPADS DISPFDB DISPFLT DISPACD DISPPAF DISPPRO DISPAQD DISPABQ DISPACR	CALLED BY: MADEM
99. DISPFDB	CALLS: OUTCI. DISPFMF	CALLED BY: DISPDAT
100. DISPFLT	CALLS: OUTCI. DISPPAY DISPAQD DISPACD DISPPRO	CALLED BY: DISPFMF DISPDAT
101. DISPFMF	CALLS: OUTCI. DISPFLT	CALLED BY: DISPFDB
102. DISPPAF	CALLS: OUTCI. DISPPYB	CALLED BY: DISPDAT
103. DISPPAY	CALLS: OUTCI. DISPPYB	CALLED BY: DISPFLT
104. DISPPRO	CALLS: OUTCI.	CALLED BY: DISPFLT DISPDAT
105. DISPPYB	CALLS: OUTCI.	CALLED BY: DISPPAY DISPPAF

106. DLYACT	CALLS:	CALLED BY:
	UNPACK	WTHDRAW
	PACK	SDIGEST
	STICK	BYALCOV
		BYCONTC
		BNCONTC
		DROPPS2
		DROPPOS
		COVAPLY
		BYUPDAT
		BYNWTRK
		BYCONHD
		BNPONSS
		BNPONEP
		BNPONDA
		BNPONBB
		BNNWTRK
		BNCONHD
107. DOGFITE	CALLS:	CALLED BY:
	GETPTRS	SELECT
	UNSTAT	
	TAPE6#	
	OUTCI.	
	HISTORY	
	FINDBLK	
	DROPBLK	
	DELADD	
	XPAA	
	RANDOM.	
	GIMME	
	DESTROY	
108. DOGTHNK	CALLS:	CALLED BY:
	MESBILD	TFLYCRC
	DELADD	
	TAPE6#	
	OUTCI.	
	GOTOAB	
	FUELCHK	
109. DROPBLK	CALLS:	CALLED BY:
	ENTRYP	SAMWYPE
	RELEASE	NUKBLND
	EXITP	NOWUCIT
		KILFLIT
		INT2CRC
		HEXMOVE
		FLTWYPE
		DOGFITE
		CRCTRAK
		CRCLOSS
		CRCKIL
		CRCDIES

		BTNASIN
		BADMOVE
		ATTACK
		AB2CRC
110. DROPPOS	CALLS:	CALLED BY:
	YANK	SEEKTAC
	RELEASE	SAMPRCM
	MESBILD	BNCONTC
	DELADD	CHKLAST
	SEEKENG	BOCTINK
	GIMME	BNPONFD
	DLYACT	BNPONEP
		BNCONLS
		BNCONHD
		BNCMDPR
111. DROPPS2	CALLS:	CALLED BY:
	YANK	SEEKENG
	RELEASE	
	MESBILD	
	DELADD	
	SEEKENG	
	GIMME	
	DLYACT	
112. ENGAGE	CALLS:	CALLED BY:
	GETPTRS	SELECT
	TRYSHOT	
	TAPE6#	
	OUTCI.	
	GIMME	
	DELADD	
	UNPACK	
	PACK	
	AMMOCHK	
	RELEASE	
	HISTORY	
113. ENTRYP	CALLS:	CALLED BY:
	MESAGE	LTRMRG
	RITEI	UNPACK
	RECER	UDLLOAD
	TAPE6#	UNSNAP
	OUTCI.	TXY2HXL
	ROUTER	TXY2HX
	ITRAP	THX2XY
	SECOND	THTRPLN
		THH2PS
		TGTGONE
		SNAP
		SELECT
		SCHTAB
		RLWAVE
		RLTGTYP

RLTGTAK
RLRAID
RLFMAKT
RLCORD
RLABDB
REVISE
RELIST
RELEASE
PTREE
PLANOUT
PLAN
PELADD
PACK
OUTA
NOWUCIT
LTREE
LOADPL
LINEX
KOMPARE
JUGGLE
JTJ
JGESUIT
INITACQ
IJ2HX
HXDGTS
HOLD
HLTPNT
HISTORY
HEXMULT
HEXMLT
HEXINV
HEXCHZ
HEXADD
GIMME
GETPTRS
GETHEX
FSDUMP
FORMTGT
FINDFLT
FINDBLK
FETCH
DROPBLK
DELADD
CREATE
CORBOUN
CONTROL
CLOSCOR
CENTER
CANOTGT
ADDBLOK
ABVSCOR
MADEM

114. ENTSTAT	CALLS:	CALLED BY:
	TAPE6#	HALT

```
                     OUTCI.                          FSDUMP

115. EOF                               CALLED BY:
                                                     DBGREAD

116. EXITP           CALLS:            CALLED BY:
                     SECOND                          LTRMRG
                     MESAGE                          UNPACK
                     RITEI                           UDLLOAD
                     RECER                           UNSNAP
                     TAPE6#                          TXY2HXL
                     OUTCI.                          TXY2HX
                     ITRAP                           THX2XY
                     ICHECK                          THTRPLN
                                                     THH2PS
                                                     TSTGONE
                                                     SNAP
                                                     SELECT
                                                     SCHTAB
                                                     RLWAVE
                                                     RLTGTYP
                                                     RLTGTAK
                                                     RLRAID
                                                     RLFMAKT
                                                     RLCORD
                                                     RLABDB
                                                     REVISE
                                                     RELIST
                                                     RELEASE
                                                     PTREE
                                                     PLANOUT
                                                     PLAN
                                                     PELADD
                                                     PACK
                                                     OUTA
                                                     NOWUCIT
                                                     LTREE
                                                     LOADPL
                                                     LINEX
                                                     KOMPARE
                                                     JUGGLE
                                                     JTJ
                                                     JGESUIT
                                                     INITACQ
                                                     IJ2HX
                                                     HXDGTS
                                                     HOLD
                                                     HLTPNT
                                                     HISTORY
                                                     HEXMULT
                                                     HEXMLT
                                                     HEXINV
                                                     HEXCHZ
                                                     HEXADD
                                                     GIMME
```

```
                                                                GETPTRS
                                                                GETHEX
                                                                FSDUMP
                                                                FORMTGT
                                                                FINDFLT
                                                                FINDBLK
                                                                FETCH
                                                                DROPBLK
                                                                DELADD
                                                                CREATE
                                                                CORBOUN
                                                                CONTROL
                                                                CLOSCOR
                                                                CENTER
                                                                CANDTGT
                                                                ADDBLOK
                                                                ABVSCOR
                                                                MADEM
117. FELDEL             CALLS:                  CALLED BY:
                                UNPACK                          SELECT
                                UNSNAP
                                RELEASE
                                TAPE6#
                                OUTCI.
118. FETCH              CALLS:                  CALLED BY:
                                ENTRYP                          MADEM
                                INPBI.
                                EXITP
119. FILERUP            CALLS:                  CALLED BY:
                                RANDOM.                         BYPONRL
                                TAPE6#                          BNPONBB
                                OUTCI.
                                GIMME
                                YANK
                                STICK
                                DELADD
120. FINDBLK            CALLS:                  CALLED BY:
                                ENTRYP                          TOWER
                                ROUTER                          THTRPLN
                                MESAGE                          SAMWYPE
                                RITEI                           REDEBRF
                                CLIST                           NUKBLND
                                EXITP                           NOWUCIT
                                                                NEWMOVE
                                                                KILFLIT
                                                                INT2CRC
                                                                HEXMOVE
                                                                GOGETEM
                                                                GNDLOOK
                                                                FORMTGT
                                                                FLTWYPE
```

```
                                                        FINDIT
                                                        FINDFLT
                                                        DOGFITE
                                                        CRCTRAK
                                                        CRCLOSS
                                                        CRCKIL
                                                        CRCEVNT
                                                        CRCDIES
                                                        CANDTGT
                                                        BTNASIN
                                                        BADMOVE
                                                        INTASIN
                                                        ATTACK
                                                        AB2CRC
121. FINDFLT         CALLS:                  CALLED BY:
                           ENTRYP                       FORMTGT
                           HEXDIST
                           FINDBLK
                           KOMPARE
                           GIMME
                           ADDBLOK
                           EXITP
122. FINDIT          CALLS:                  CALLED BY:
                           FINDBLK                      INTFIND
                           GIMME
                           ADDBLOK
123. FIRECHK         CALLS:                  CALLED BY:
                           THX2XY                       TRYSHOT
                           SIN.
                           COS.
                           SQRT.
                           ATAN2.
                           ASIN.
124. FLITE           CALLS:                  CALLED BY:
                           INTRFLY                      FLY
                           UNPACK
                           COMMAND
                           HEXCHZ
                           OPTPTH
                           RELEASF
                           SIN.
                           DELADD
125. FLTGEOM         CALLS:                  CALLED BY:
                           PACK                         GOGETEM
                           HEXCHZ                       ACFRAG
                           THH2PS
                           ATAN2.
126. FLTWYPE         CALLS:                  CALLED BY:
                           UNPACK                       KILFLIT
```

	RELEASE	GOTOAB
	FINDBLK	COMMAND
	TRACE	
	MESAGE	
	RITEI	
	CLIST	
	FSDUMP	
	DROPBLK	
	PACK	
127. FLY	CALLS:	CALLED BY:
	GETPTRS	SELECT
	UNSTAT	
	HEXMOVE	
	FUELCHK	
	SHRKILL	
	FLITE	
	DELADD	
	STATPAK	
	GIMME	
	PACK	
	TAPE6#	
	OUTCI.	
	DESTROY	
128. FLYSEE	CALLS:	CALLED BY:
	DELADD	CFLYCRC
	GIMME	
	ADDBLOK	
	TAPE6#	
	OUTCI.	
	MESBILD	
	RELEASE	
	HEXDIST	
	DETECT	
	HISTORY	
129. FORMTGT	CALLS:	CALLED BY:
	ENTRYP	CANDTGT
	GIMME	
	FINDBLK	
	FINDFLT	
	RELEASE	
	EXITP	
130. FSDUMP	CALLS:	CALLED BY:
	ENTRYP	YANK
	TRACE	UNSTAT
	ENTSTAT	TRKCHEK
	CLIST	JTJ
	RITER	FLTWYPE
	LNPLOT	
	LCMLOC	
	TAPE6#	
	OUTCI.	

	OUTCR.	
	EXITP	
131. FSINIT		CALLED BY:
		MADEM
132. FUELCHK	CALLS:	CALLED BY:
	UNPACK	FLY
	HEXDIST	DOGTHNK
	GOTOAB	
	TAPE6#	
	OUTCI.	
	MESBILD	
	DELADD	
133. GETHEX	CALLS:	CALLED BY:
	ENTRYP	TXY2HXL
	HXDGTS	SCHEDUL
	MESAGE	PTRAND
	RITEI	NUKBLND
	GIMME	NOWUCIT
	SCHTAB	HEXCHZ
	EXITP	
134. GETPTRS	CALLS:	CALLED BY:
	ENTRYP	TOWER
	EXITP	RONDSEE
		PONDER
		PLAN
		PERCEPT
		SAMPRCH
		FLY
		ENGAGE
		DOGFITE
		DESTROY
		BYPASUP
		BYENOPS
		ATTACK
		ASSIGN
135. GIMME	CALLS:	CALLED BY:
	ENTRYP	WTHDRAW
	HALT	UDLLOAD
	MESAGE	UMPIRE
	RITEI	TOWER
	RITEP	TGADIL
	EXITP	TGTGONE
		SHRKILL
		SEEKTAC
		SEEKENG
		SDIGEST
		SAMWYPE
		REVISE
		RESUPLY
		RELOAD

RELEASE
REDEBRF
BYALCOV
PELADD
OPTPTH
NUKBLNO
NOWUCIT
NEWPERC
NEWMOVE
BYCONTC
BNCONTC
NAYBOR
MESBILD
KILFLIT
INT2CRC
INITACQ
GOGETEM
GETHEX
FORMTGT
FLYSEE
FLY
FINDIT
FINDFLT
FILERUP
ENGAGE
DROPPS2
DROPPOS
DOGFITE
DESTROY
DELADD
CRFLTML
CREATE
CRCSEE
CRCEVNT
COVAPLY
CORBOUN
CHKCOV
CANDTGT
BYUPDAT
BYPONTM
BYPASUP
BYNWTRK
BYCONHD
BNPONSS
BNPONEP
BNPONDA
BNPONBB
BNNWTRK
BNCONHD
BATTOUT
BATCEAS
BADMOVE
ATKASES
ALLOPAT
ALLOFU

		ALLUBAT
		ACFRAG
		ACCEPT
		ABVSCOR
		AB2CRC
136. GNDLOOK	CALLS:	CALLED BY:
	FINDBLK	CFLYCRC
	XPD	
	RANDOM.	
	DELADD	
	HISTORY	
	TAPE6#	
	OUTCI.	
	UNPACK	
	THH2PS	
	ATAN2.	
137. GOGETEM	CALLS:	CALLED BY:
	UNPACK	TOWER
	FINDBLK	
	CRFLTML	
	TAPE6#	
	OUTCI.	
	GIMME	
	ADDBLOK	
	PTRAND	
	PACK	
	FLTGEOM	
	UDLLOAD	
	INITACQ	
	DELADD	
	MESBILD	
138. GOTOAB	CALLS:	CALLED BY:
	UNPACK	FUELCHK
	FLTWYPE	DOGTHNK
	OPTPTH	
	RELEASE	
	THH2PS	
	ATAN2.	
139. HALT	CALLS:	CALLED BY:
	HOLD	UNPACK
	OUTCI.	ITRAP
	RITER	RECCON
	RITEI	SELECT
	TRACE	RELEASE
	RECER	PACK
	ENTSTAT	HLTPNT
	CLIST	GIMME
	PAGE	MADEM
	ADUMP	
	ISDUMP	
	ENDFIL.	

STOP.

140. HANDZPT	CALLS: BATCEAS, YANK, STICK, TOADIL, RELOCAT, DILOUT	CALLED BY: BNLALLE
141. HEXADD	CALLS: ENTRYP, ITOJ., EXITP	CALLED BY: SCHEDUL, PTRAND, NUKBLND, NOWUCIT, HEXMLT, HEXCHZ
142. HEXCHZ	CALLS: ENTRYP, TRACE, MESAGE, RITEP, CLIST, HEXADD, HEXINV, GETHEX, EXITP	CALLED BY: OPTPTH, FLTGEOM, FLITE
143. HEXDIST		CALLED BY: SCHEDUL, NAYBOR, INTRFLY, FUELCHK, FLYSEE, FINDFLT, DETECT, CRCEVNT, CORBOUN, CLOSCOR, BTNASIN, BADMOVE, INTASIN, AIRTHNK, ACFRAG
144. HEXINV	CALLS: ENTRYP, ITOJ., EXITP	CALLED BY: HEXCHZ
145. HEXMLT	CALLS: HEXADD, ENTRYP, HXDGTS	CALLED BY: IJ2HX

```
                              MESAGE
                              RITEI
                              EXITP

146. HEXMOVE           CALLS:                       CALLED BY:
                              TRACE                           FLY
                              MESAGE
                              RITEI
                              CLIST
                              UNPACK
                              XTOI.
                              NOWUCIT
                              FINDBLK
                              DROPBLK
                              RELEASE
                              PACK
                              UOLLOAD

147. HEXMULT           CALLS:                       CALLED BY:
                              ENTRYP                          PTRAND
                              ITOJ.                           NOWUCIT
                              EXITP

148. HISTORY           CALLS:                       CALLED BY:
                              ENTRYP                          UMPIRE
                              MESAGE                          SHRKILL
                              MASKER                          NEWPERC
                              TAPE6#                          NEWMOVE
                              OUTCI.                          GNDLOOK
                              EXITP                           FLYSEE
                                                              ENGAGE
                                                              DOGFITE
                                                              CRFLTML
                                                              BADMOVE
                                                              ATTACK

149. HLTPNT            CALLS:                       CALLED BY:
                              ENTRYP                          CONTROL
                              SECOND
                              HALT
                              EXITP

150. HOLD              CALLS:                       CALLED BY:
                              ENTRYP                          HALT
                              OUTBI.
                              REWIND.
                              EXITP

151. HXDGTS            CALLS:                       CALLED BY:
                              ENTRYP                          TH2HX
                              EXITP                           THX2XY
                                                              HEXMLT
                                                              GETHEX

152. HXMLT2            CALLS:
```

	TH2HX IJ2HX	
153. ICHECK	CALLS: OUTCI.	CALLED BY: EXITP
154. IJ2HX	CALLS: HEXMLT ENTRYP ITOJ. EXITP	CALLED BY: XY2HX TXY2HXL HXMLT2
155. INIT		CALLED BY: MADEM
156. INITACQ	CALLS: ENTRYP GIMME ADDBLOK ALOG. MESAGE RITEI XTOI. NOWUCIT EXITP	CALLED BY: TOWER GOGETEM
157. INRANGE	CALLS: THH2PS ATAN2. SQRT. COS. TAPE6# OUTCI. AZILIM	CALLED BY: BYCONTC CHKCOV BYPONRL BYNWTRK BNPONBB
158. INSECT	CALLS: TAN. ATAN2.	CALLED BY: AZILIM
159. INSERT	CALLS: UNPACK XSHIFT	CALLED BY: SSLL
160. INTASIN	CALLS: FINDBLK TRACE MESAGE RITEI CLIST UNPACK HEXDIST TGTHEX MESBILD PACK DELADD	CALLED BY: ASSIGN

```
                    TAPE6#
                    OUTCI.
                    BTNASIN

161. INTFIND        CALLS:
                    UNPACK
                    TAPE6#
                    OUTCI.
                    FINDIT
                    PACK
                    MESBILD
                    DELADD

162. INTRFLY        CALLS:                  CALLED BY:
                    TGTHEX                            FLITE
                    HEXDIST
                    MESBILD
                    DELADD
                    TAPE6#
                    OUTCI.
                    UNPACK
                    THH2PS
                    ATAN2.
                    OPTPTH
                    RELEASE

163. INT2CRC        CALLS:                  CALLED BY:
                    UNPACK                            CRCTHNK
                    FINDBLK
                    RELEASE
                    CRCKIL
                    TAPE6#
                    OUTCI.
                    DETECT
                    MESBILD
                    DELADD
                    DROPBLK
                    GIMME
                    ADDBLOK

164. IPJL           CALLS:
                    LCMLOC
                    ISHIFT
                    TAPE6#
                    OUTCI.

165. ISDUMP         CALLS:                  CALLED BY:
                    OUTCI.                            HALT
                    OUTCR.                            UNPACK
                                                      PACK

166. ISHIFT                                 CALLED BY:
                                                      SSLL
                                                      PTREE
                                                      LOSRADR
```

```
                                                                              JTJ
                                                                              IPJL

167. ITRAP                  CALLS:                       CALLED BY:
                                   HALT                                       EXITP
                                                                              ENTRYP
                                                                              THTRPLN

168. JGESUIT                CALLS:                       CALLED BY:
                                   ENTRYP                                     CANDTGT
                                   THX2XY
                                   ATAN2.
                                   EXITP

169. JTJ                    CALLS:
                                   ENTRYP
                                   MESAGE
                                   RITEI
                                   ISHIFT
                                   TAPE6#
                                   OUTCI.
                                   FSDUMP
                                   STOP.
                                   EXITP

170. JUGGLE                 CALLS:                       CALLED BY:
                                   ENTRYP                                     THX2XY
                                   EXITP

171. KILFLIT                CALLS:                       CALLED BY:
                                   GIMME                                      DESTROY
                                   DELADD
                                   STOP.
                                   UNPACK
                                   RELEASE
                                   UNSTAT
                                   FLTWYPE
                                   FINDBLK
                                   DROPBLK

172. KOMPARE                CALLS:                       CALLED BY:
                                   ENTRYP                                     THTRPLN
                                   UNPACK                                     FINDFLT
                                   PACK
                                   EXITP

173. LCMLOC                                              CALLED BY:
                                                                              UNPACK
                                                                              RITEP
                                                                              PACK
                                                                              IPJL
                                                                              FSDUMP
                                                                              MADEM

174. LINEX                  CALLS:                       CALLED BY:
```

```
                          ENTRYP                               OPTPTH
                          EXITP                                CORBOUN

175. LNPLOT          CALLS:                        CALLED BY:
                          TAPE6#                               CLIST2
                          OUTCI.                               OUTPTRS
                                                               FSDUMP
                                                               CLIST

176. LOADPL          CALLS:
                          ENTRYP
                          EXITP

177. LOSRADR         CALLS:                        CALLED BY:
                          ISHIFT                               BYTKCHK
                          OPTPTH                               DETECT
                          THH2PS                               CRCEVNT
                          SQRT.
                          COS.
                          UNPACK
                          RELEASE

178. LRKPRS                                        CALLED BY:
                                                               MADEM

179. LTREE           CALLS:                        CALLED BY:
                          ENTRYP                               CONTROL
                          RELEASE
                          LTRMRG
                          EXITP

180. LTRMRG          CALLS:                        CALLED BY:
                          ENTRYP                               LTREE
                          EXITP                                DELADD

181. MADEM           CALLS:
                          QINTRY.
                          RECCON
                          ENTRYP
                          INPFI.
                          DBGREAD
                          RECOVR
                          GOTOER.
                          FETCH
                          PAGE
                          LCMLOC
                          FSINIT
                          OTHRDAT
                          DISPDAT
                          HALT
                          INIT
                          LRKPRS
                          RELIST
                          DELADD
                          CONTROL
```

```
                         EXITP
                         END.

182. MASKER                                   CALLED BY:
                                                   HISTORY

183. MESAGE          CALLS:                   CALLED BY:
                         TAPE6#                    CLIST2
                         OUTCI.                    EXITP
                                                   ENTRYP
                                                   UNSTAT
                                                   TGTHEX
                                                   SELECT
                                                   RELEASE
                                                   PACK
                                                   OUTPTRS
                                                   TRKCHEK
                                                   SAMPRCM
                                                   NAYBOR
                                                   JTJ
                                                   INITACQ
                                                   HISTORY
                                                   HEXMOVE
                                                   HEXMLT
                                                   HEXCHZ
                                                   GIMME
                                                   GETHEX
                                                   FLTWYPE
                                                   FINDBLK
                                                   DELADD
                                                   CRCDIES
                                                   CLIST
                                                   INTASIN
184. MESBILD         CALLS:                   CALLED BY:
                         GIMME                     TOWER
                         PACK                      BYCONTC
                                                   BNLALLE
                                                   INTRFLY
                                                   INT2CRC
                                                   INTFIND
                                                   CRC2INT
                                                   GOGETEM
                                                   FUELCHK
                                                   FLYSEE
                                                   DROPPS2
                                                   DROPPOS
                                                   DOGTHNK
                                                   DECRALD
                                                   CRCTRAK
                                                   COMMAND
                                                   BYPONRL
                                                   BYPONFD
                                                   BYPONER
                                                   BYNWTRK
```

			BYHEDUP
			BYCONLS
			BTRYTNK
			BTNASIN
			BOCTINK
			BNPONFD
			BNPONEP
			BNCONLS
			BNCONHO
			BNCMOPR
			BADMOVE
			INTASIN
			AMMOCHK
			ALLOBAT
			AIRTHNK
185. NAYBOR	CALLS:	CALLED BY:	
	UNPACK		SELECT
	MESAGE		
	RITEI		
	TRACE		
	CLIST		
	HEXDIST		
	GIMME		
	DELADD		
	RELEASE		
186. NEWMOVE	CALLS:	CALLED BY:	
	FINDBLK		CRCTRAK
	RANDOM.		
	TAPE6#		
	OUTCI.		
	GIMME		
	ADDBLOK		
	HISTORY		
	DELADD		
187. NEWPERC	CALLS:	CALLED BY:	
	HISTORY		SAMPRCM
	GIMME		BYPASUP
	STICK		
	DELADD		
188. NOWUCIT	CALLS:	CALLED BY:	
	ENTRYP		TERMACQ
	HEXADD		INITACQ
	HEXMULT		HEXMOVE
	GETHEX		
	GIMME		
	ADDBLOK		
	FINDBLK		
	DROPBLK		
	RELEASE		
	EXITP		

```
189. NUKBLND          CALLS:                  CALLED BY:
                             UNPACK                       UMPIRE
                             GIMME                        ATTACK
                             HEXADD
                             GETHEX
                             TAPE6#
                             OUTCI.
                             DELADD
                             SAMWYPE
                             TERMACQ
                             FINDBLK
                             RELEASE
                             DROPBLK
                             UNLINK

190. OPTPTH           CALLS:                  CALLED BY:
                             GIMME                        RONDSEE
                             THH2PS                       LOSRADR
                             HEXCHZ                       INTRFLY
                             LINEX                        CRC2INT
                             PACK                         GOTOAB
                                                          FLITE
                                                          CORBOUN
                                                          ACFRAG

191. OTHRDAT                                  CALLED BY:
                                                          MADEM

192. OUTA             CALLS:                  CALLED BY:
                             ENTRYP                       YANK
                             TAPE6#                       CHKCOV
                             OUTCI.                       ALLOBAT
                             EXITP                        ACCEPT

193. OUTPTRS          CALLS:
                             LNPLOT
                             MESAGE
                             RITEI
                             RITER
                             RITEP
                             UNPACK

194. PACK             CALLS:                  CALLED BY:
                             ENTRYP                       YANK
                             LCMLOC                       WTHDRAW
                             PAGE                         UMPIRE
                             MESAGE                       TOWER
                             RITEI                        STICK
                             TRACE                        SHRKILL
                             ROUTER                       SETASSN
                             RITEP                        SEEKTAC
                             ISDUMP                       SDIGEST
                             HALT                         PTPONER
                             EXITP                        BYALCOV
```

```
                                                              PREPAFU
                                                              OPTPTH
                                                              MESBILD
                                                              KOMPARE
                                                              INTFIND
                                                              HEXMOVE
                                                              GOGETEM
                                                              FLY
                                                              FLTWYPE
                                                              FLTGEOM
                                                              ENGAGE
                                                              OLYACT
                                                              CRFLTML
                                                              COMMO
                                                              BYUPDAT
                                                              BYPONTM
                                                              BYPONER
                                                              BYPASUP
                                                              BTNASIN
                                                              BNRECOV
                                                              BNPONEP
                                                              BNCONHQ
                                                              INTASIN
                                                              ALLOBAT
                                                              ACFRAG
                                                              ACCEPT
195. PAGE           CALLS:                      CALLED BY:
                          TAPE6#                              CLIST2
                          OUTCI.                              HALT
                                                              PACK
                                                              CLIST
                                                              MADEM
196. PATDEC         CALLS:                      CALLED BY:
                          CANCALD                             BYALCOV
                          SEEKTFU
197. PELADD         CALLS:                      CALLED BY:
                          ENTRYP                              REDEBRF
                          GIMME                               CANOTGT
                          PTRMRG                              AVAILBL
                          EXITP
198. PERCEPT        CALLS:                      CALLED BY:
                          GETPTRS                             SELECT
                          ABSEE
                          CFLYCRC
                          SAMSEE
199. PLAN           CALLS:                      CALLED BY:
                          ENTRYP                              SELECT
                          GETPTRS
                          THTRPLN
                          EXITP
```

```
200. PLANOUT          CALLS:                  CALLED BY:
                             ENTRYP                      THTRPLN
                             OUTCI.
                             EXITP

201. PONDER           CALLS:                  CALLED BY:
                             GETPTRS                     SELECT
                             TFLYCRC
                             BOCTINK
                             BTRYTNK

202. PREPAFU          CALLS:                  CALLED BY:
                             UNPACK                      BYCONTC
                             PACK                        BYPONRL
                             AUTOPRI                     BYNWTRK
                             STICK
                             RELOCAT
                             DELADD

203. PRIORTY                                  CALLED BY:
                                                         SETASSN
                                                         CHKLAST
                                                         BNPONBB
                                                         BNCONHO
                                                         ALLOBAT

204. PTPONER          CALLS:                  CALLED BY:
                             UNPACK                      BYPONER
                             PACK
                             CANCALO
                             SEEKTFU
                             OILOUT
                             DELADD

205. PTRAND           CALLS:                  CALLED BY:
                             UNPACK                      GOGETEM
                             RANDOM.
                             HEXADD
                             HEXMULT
                             GETHEX

206. PTREE            CALLS:                  CALLED BY:
                             ENTRYP                      TGTGONE
                             RELEASE                     CANOTGT
                             ISHIFT
                             EXITP

207. PTRMRG                                   CALLED BY:
                                                         PELADD

208. READIL           CALLS:                  CALLED BY:
                             UNPACK                      SEEKTAC
                             YANK                        CANCALO
                             STICK                       BNPONEP
```

	TAPE6#	
	OUTCI.	
	RELOCAT	
	DELADD	
209. RECCON	CALLS:	CALLED BY:
	TAPE6#	MADEM
	OUTCI.	
	ADUMP	
	HALT	
210. RECER	CALLS:	CALLED BY:
	TAPE6#	HALT
	OUTCI.	EXITP
	OUTCR.	ENTRYP
		DELADD
211. RECOVR		CALLED BY:
		MADEM
212. REDEBRF	CALLS:	CALLED BY:
	UNPACK	TOWER
	FINDBLK	
	WIPEOUT	
	GIMME	
	ADDBLOK	
	PELADD	
	DESTROY	
213. RELEASE	CALLS:	CALLED BY:
	ENTRYP	WTHDRAW
	MESAGE	UMPIRE
	RITEI	TERMAC0
	RITEP	SEEKTAC
	HALT	SEEKENG
	GIMME	SDIGEST
	EXITP	SAMWYPE
		SAMSEE
		SAMATON
		RONDSEE
		RLWAVE
		RLTGTYP
		RLTGTAK
		RLRAID
		RLFMAKT
		RLCORD
		RLABDB
		REVISE
		RELSILL
		RELIST
		PTREE
		BYALCOV
		NUKBLND
		SAMPRCM
		NOWUCIT

NAYBOR
LTREE
LOSRADR
KILFLIT
INTRFLY
INT2CRC
CRC2INT
HEXMOVE
GOTOAB
FORMTGT
FLYSEE
FLTWYPE
FLITE
FELDEL
ENGAGE
DROPPS2
DROPPOS
DROPBLK
DILOUT
DESTROY
CRCTHNK
CRCSEE
CRCKIL
CRCEVNT
CRCDIES
COVAPLY
CONTROL
COMMO
CNACTTK
CANCALO
BYUPDAT
BYPONTM
BYPONRS
BYPONFD
BYPONER
BYHEDUP
BYENDPS
BYCMDPR
BTN2CRC
BTNASIN
BOCTINK
BNPONFD
BNPONDA
BNPONBD
BNNOTRD
BNCONHD
BATTOUT
BATCEAS
BADMOVE
AVAILBL
ACFRAG
ACCEPT
ABSEE
AB2CRC

214. RELIST	CALLS:	CALLED BY:
	ENTRYP	MADEM
	RELEASE	
	EXITP	
215. RELOAD	CALLS:	CALLED BY:
	GIMME	BYPONRS
	GOTOER.	
	DELADD	
	RESUPLY	
216. RELOCAT	CALLS:	CALLED BY:
	YANK	TOADIL
	STICK	SETASSN
		SAMATON
		READIL
		PREPAFU
		HANDZPT
		BYCONTC
		CHKLAST
		BYNWTRK
		BYHEDUP
		BYCONHO
		BNPONBB
217. RELSILL	CALLS:	
	RELEASE	
218. RENDEVU	CALLS:	CALLED BY:
	UNPACK	SCHEDUL
	THX2XY	
	TXY2HXL	
219. RESUPLY	CALLS:	CALLED BY:
	GIMME	RELOAD
	DELADD	
220. REVISE	CALLS:	CALLED BY:
	ENTRYP	THTRPLN
	GIMME	
	ABVSCOR	
	RELEASE	
	EXITP	
221. RITEI	CALLS:	CALLED BY:
	TAPE6#	CLIST2
	OUTCI.	HALT
		EXITP
		ENTRYP
		TGTHEX
		SELECT
		RELEASE
		PACK
		OUTPTRS

```
                                                        TRKCHEK
                                                        NAYBOR
                                                        JTJ
                                                        INITACQ
                                                        HEXMOVE
                                                        HEXMLT
                                                        GIMME
                                                        GETHEX
                                                        FLTWYPE
                                                        FINDBLK
                                                        CRCDIES
                                                        CLIST
                                                        INTASIN
222. RITEP              CALLS:                  CALLED BY:
                              LCMLOC                    CLIST2
                              TAPE6#                    UNPACK
                              OUTCI.                    RELEASE
                                                        PACK
                                                        OUTPTRS
                                                        SAMPRCM
                                                        HEXCHZ
                                                        GIMME
                                                        CLIST
223. RITER              CALLS:                  CALLED BY:
                              TAPE6#                    CLIST2
                              OUTCI.                    HALT
                                                        OUTPTRS
                                                        FSDUMP
                                                        CLIST
224. RLABDB             CALLS:                  CALLED BY:
                              ENTRYP                    RLCORD
                              RELEASE
                              EXITP
225. RLCORD             CALLS:                  CALLED BY:
                              ENTRYP                    RLRAID
                              RLABDB
                              RELEASE
                              EXITP
226. RLFMAKT            CALLS:                  CALLED BY:
                              ENTRYP                    RLTGTAK
                              RELEASE
                              EXITP
227. RLRAID             CALLS:                  CALLED BY:

                                                        BYPONER
                                                        BATCEAS
245. SELECT             CALLS:                  CALLED BY:
```

```
                              ENTRYP                         CONTROL
                              GOTOER.
                              MESAGE
                              RITEI
                              HALT
                              FELDEL
                              ASSIGN
                              ATTACK
                              COMMO
                              DOGFITE
                              ENGAGE
                              FLY
                              NAYBOR
                              PERCEPT
                              PLAN
                              PONDER
                              TOWER
                              UMPIRE
                              TAPE6#
                              OUTCI.
                              OUTCR.
                              EXITP
246. SETASSN          CALLS:                    CALLED BY:
                              UNPACK                         BNCONTC
                              PACK                           BNPONDA
                              STICK                          BNPONBB
                              PRIORTY                        BNNWTRK
                              RELOCAT
                              DELADD
247. SHRKILL          CALLS:                    CALLED BY:
                              ALOG.                          FLY
                              RANDOM.                        ATTACK
                              HISTORY
                              UNPACK
                              TAPE6#
                              OUTCI.
                              GIMME
                              PACK
                              DELADD
                              DESTROY
248. SHUFFLE                                    CALLED BY:
                                                             TH2HX
249. SKSBTRK          CALLS:                    CALLED BY:
                              UNPACK                         BNPONEP
                              SEEKP
250. SNAP             CALLS:                    CALLED BY:
                              ENTRYP                         DELADD
                              EXITP                          CONTROL
251. SSLL             CALLS:                    CALLED BY:
```

```
                        UNPACK                      WTHORAW
                        ISHIFT                      SEEKTAC
                        INSERT                      SEEKENG
                                                    BYALCOV
                                                    BYUPDAT
                                                    BATTOUT

252. STATPAK                              CALLED BY:
                                                    TFLYCRC
                                                    RONDSEE
                                                    FLY
                                                    CFLYCRC
                                                    ATTACK

253. STICK            CALLS:              CALLED BY:
                        UNPACK                      TOADIL
                        PACK                        SETASSN
                                                    SDIGEST
                                                    READIL
                                                    PREPAFU
                                                    TRKCHEK
                                                    RELOCAT
                                                    HANDZPT
                                                    NEWPERC
                                                    BYTKCHK
                                                    BYCONTC
                                                    BNLALLE
                                                    BNCONTC
                                                    FILERUP
                                                    DLYACT
                                                    BYNWTRK
                                                    BYCONHO
                                                    BNPONEP
                                                    BNPONBB
                                                    BNCONHO
                                                    BATCEAS
                                                    ALLOPAT
                                                    ALLOFU
                                                    ALLOBAT
                                                    ACCEPT

254. TERMACQ          CALLS:              CALLED BY:
                        UNPACK                      NUKBLND
                        XTOI.                       DESTROY
                        NOWUCIT
                        RELEASE

255. TFLYCRC          CALLS:              CALLED BY:
                        CRCTHNK                     PONDER
                        UNSTAT
                        AIRTHNK
                        DOGTHNK
                        STATPAK

256. TGTGONE          CALLS:              CALLED BY:
```

	CALLS:	CALLED BY:
	ENTRYP	CANOTGT
	PTREE	
	GIMME	
	EXITP	
257. TGTHEX	TRACE	INTRFLY
	MESAGE	BADMOVE
	RITEI	INTASIN
	CLIST	AIRTHNK
	UNPACK	
	THH2PS	
	ATAN2.	
	COS.	
	SQRT.	
	SIN.	
	TXY2HXL	
258. THH2PS	ENTRYP	UMPIRE
	THX2XY	TGTHEX
	EXITP	RONDSEE
		OPTPTH
		TRKCHEK
		INRANGE
		LOSRADR
		INTRFLY
		CRC2INT
		GOTOAB
		GNDLOOK
		FLTGEOM
		DETECT
		CORBOUN
		COMMAND
		ATKASES
259. THTRPLN	ENTRYP	PLAN
	CORBOUN	
	REVISE	
	FINDBLK	
	KOMPARE	
	CANOTGT	
	ITRAP	
	AVAILBL	
	SCHEDUL	
	DELADD	
	PLANOUT	
	RLRAID	
	EXITP	
260. THX2XY	ENTRYP	THH2PS
	HXDGTS	RENDEVU
	JUGGLE	JGESUIT

	EXITP	FIRECHK
261. TH2HX	CALLS:	CALLED BY:
	HXDGTS	HXMLT2
	SHUFFLE	
262. TOADIL	CALLS:	CALLED BY:
	TAPE6#	SOIGEST
	OUTCI.	SAMATON
	YANK	TRKCHEK
	STICK	HANDZPT
	RELOCAT	BYTKCHK
	GIMME	BYCONTC
		BNCONTC
		OILOUT
		ALLOBAT
263. TOWER	CALLS:	CALLED BY:
	GETPTRS	SELECT
	TAPE6#	
	OUTCI.	
	UNPACK	
	UOLLOAD	
	INITACQ	
	DELADD	
	PACK	
	FINDBLK	
	REDEBRF	
	GIMME	
	GOGETEM	
	MESBILD	
	DESTROY	
264. TRACE	CALLS:	CALLED BY:
	TRPRRT	HALT
	TRPRMT	YANK
	TRPRNT	UNSTAT
		TGTHEX
		PACK
		SAMPRCM
		NAYBOR
		HEXMOVE
		HEXCHZ
		FSDUMP
		FLTWYPE
		DELADD
		CRCDIES
		INTASIN
265. TRKCHEK	CALLS:	CALLED BY:
	THH2PS	SEEKTFU
	SQRT.	BATTCOV
	ATAN2.	
	YANK	
	MESAGE	

	RITEI CLIST FSDUMP STICK TOADIL BNLALLE	
266. TRPRMT		CALLED BY: TRACE
267. TRPRNT	CALLS: TAPE6# OUTCI.	CALLED BY: TRACE
268. TRPRRT		CALLED BY: TRACE
269. TRYSHOT	CALLS: GOTOER. TAPE6# OUTCI. YANK BATCEAS BNLALLE FIRECHK	CALLED BY: ENGAGE BYPONTM
270. TXY2HX	CALLS: ENTRYP EXITP	
271. TXY2HXL	CALLS: ENTRYP COS. SIN. XTOI. CENTER IJ2HX GETHEX EXITP	CALLED BY: TGTHEX RENDEVU CORBOUN
272. UMPIRE	CALLS: UNPACK THH2PS SQRT. XTOI. HISTORY RANDOM. TAPE6# OUTCI. GIMME PACK DELADD DESTROY RELEASE NUKBLND	CALLED BY: SELECT

273. UNLINK	CALLS:	CALLED BY:
	UNPACK	NUKBLND
		DESTROY
274. UNPACK	CALLS:	CALLED BY:
	ENTRYP	YANK
	LCMLOC	WTHDRAW
	RITEP	UNSTAT
	ISDUMP	UNLINK
	HALT	UMPIRE
	EXITP	TOWER
		TGTHEX
		TERMACQ
		STICK
		SSLL
		SKSBTRK
		SHRKILL
		SETASSN
		SEEKTAC
		SDIGEST
		SCHEDUL
		SAMWYPE
		SAMATON
		RONDSEE
		RENDEVU
		REDEBRF
		READIL
		PTRAND
		PTPONER
		BYALCOV
		PREPAFU
		OUTPTRS
		NUKBLND
		BYCONTC
		NAYBOR
		LOSRADR
		KOMPARE
		KILFLIT
		INTRFLY
		INT2CRC
		INTFIND
		CRC2INT
		INSERT
		HEXMOVE
		GOTOAB
		GOGETEM
		GNDLOOK
		FUELCHK
		FLTWYPE
		FLITE
		FELDEL
		ENGAGE
		DLYACT
		DILOUT

```
                                                            DETECT
                                                            CRFLTML
                                                            CRCTRAK
                                                            CRCTHNK
                                                            CRCSEE
                                                            CRCLOSS
                                                            CRCKIL
                                                            CRCEVNT
                                                            CRCDIES
                                                            COMMO
                                                            COMMAND
                                                            CHKCOV
                                                            BYUPDAT
                                                            BYPONTM
                                                            BYPONRS
                                                            BYPONRL
                                                            BYPONER
                                                            BYPASUP
                                                            BYNOTRD
                                                            BYHEDUP
                                                            BYENDPS
                                                            BTN2CRC
                                                            BTNASIN
                                                            BNRECOV
                                                            BNPONSS
                                                            BNPONEP
                                                            BNPONDA
                                                            BNPONBB
                                                            BATTOUT
                                                            BATCEAS
                                                            BADMOVE
                                                            INTASIN
                                                            ACFRAG
                                                            ACCEPT
                                                            ABSEE
                                                            AB2CRC
275. UNSNAP           CALLS:                  CALLED BY:
                            ENTRYP                          FELDEL
                            EXITP                           CONTROL

276. UNSTAT           CALLS:                  CALLED BY:
                            TRACE                           TFLYCRC
                            MESAGE                          RONDSEE
                            CLIST                           KILFLIT
                            FSDUMP                          FLY
                            STOP.                           DOGFITE
                            UNPACK                          DESTROY
                                                            CFLYCRC
                                                            ATTACK

277. UOLLOAD          CALLS:                  CALLED BY:
                            ENTRYP                          TOWER
                            GIMME                           HEXMOVE
                            ADDBLOK                         GOGETEM
```

```
                    EXITP

278. WIPEOUT                                 CALLED BY:
                                                  REDEBRF

279. WTHORAW          CALLS:                 CALLED BY:
                           UNPACK                 BNRECOV
                           GIMME
                           PACK
                           SSLL
                           DECRALO
                           SEEKENG
                           OLYACT
                           RELEASE

280. XPAA                                    CALLED BY:
                                                  DOGFITE

281. XPD                                     CALLED BY:
                                                  GNOLOOK

282. XPK                                     CALLED BY:
                                                  ATTACK

283. XSHIFT                                  CALLED BY:
                                                  INSERT

284. XY2HX            CALLS:
                           CENTER
                           IJ2HX

285. YANK             CALLS:                 CALLED BY:
                           UNPACK                 TRYSHOT
                           TAPE6#                 TOADIL
                           OUTCI.                 SEEKTAC
                           TRACE                  SDIGEST
                           OUTA                   READIL
                           FSDUMP                 TRKCHEK
                           STOP.                  SAMPRCM
                           PACK                   RELOCAT
                                                  HANDZPT
                                                  BYTKCHK
                                                  BYCONTC
                                                  BNLALLE
                                                  BNCONTC
                                                  FILERUP
                                                  DROPPS2
                                                  DROPPOS
                                                  DILOUT
                                                  CNACTTK
                                                  CANCALD
                                                  BYPONFD
                                                  BYENDPS
                                                  BTRYTNK
                                                  BNPONFD
```

BNPONEP
BNPONDA
BNCONHO
BATTOUT
ALLOBAT

FORTRAN LIBRARY REFERENCE LIST - MADEM

```
 1. ALOG.                                 CALLED BY:
                                                     SHRKILL
                                                     INITACQ

 2. ASIN.                                 CALLED BY:
                                                     FIRECHK

 3. ATAN2.                                CALLED BY:
                                                     TGTHEX
                                                     RONDSEE
                                                     TRKCHEK
                                                     INRANGE
                                                     BYTKCHK
                                                     JGESUIT
                                                     INTRFLY
                                                     CRCZINT
                                                     INSECT
                                                     GOTOAB
                                                     GNDLOOK
                                                     FLTGEOM
                                                     FIRECHK
                                                     DETECT
                                                     COMMAND
                                                     ATKASES

 4. COS.                                  CALLED BY:
                                                     TXY2HXL
                                                     TGTHEX
                                                     INRANGE
                                                     LOSRADR
                                                     FIRECHK
                                                     DETECT
                                                     CRCEVNT
                                                     CORBOUN
                                                     AZILIM

 5. DECODI.                               CALLED BY:
                                                     DBGREAD

 6. ENDFIL.                               CALLED BY:
                                                     HALT

 7. END.                                  CALLED BY:
                                                     MADEM

 8. GOTOER.                               CALLED BY:
                                                     TRYSHOT
                                                     SELECT
                                                     SAMTYPE
                                                     RELOAD
                                                     COMMAND
```

```
                                                    BYPONRL
                                                    BNPONSS
                                                    BNPONEP
                                                    BNPONDA
                                                    BNPONBB
                                                    BNCMOPR
                                                    AMMOCHK
                                                    MADEM

  9. INPBI.                              CALLED BY:
                                                    FETCH

 10. INPCI.                              CALLED BY:
                                                    DBGREAD

 11. INPFI.                              CALLED BY:
                                                    MADEM

 12. ITOJ.                               CALLED BY:
                                                    IJ2HX
                                                    HEXMULT
                                                    HEXINV
                                                    HEXADD
                                                    DGTSHX

 13. OUTBI.                              CALLED BY:
                                                    HOLD

 14. OUTCI.                              CALLED BY:
                                                    CLIST2
                                                    ISDUMP
                                                    HALT
                                                    ADUMP
                                                    DBGREAD
                                                    ICHECK
                                                    DISPPYB
                                                    DISPPRO
                                                    DISPPAY
                                                    DISPPAF
                                                    DISPFMF
                                                    DISPFLT
                                                    DISPFDB
                                                    DISPAQD
                                                    DISPADS
                                                    DISPACR
                                                    DISPACL
                                                    DISPACD
                                                    DISPABQ
                                                    DISPDAT
                                                    EXITP
                                                    ENTRYP
                                                    ENTSTAT
                                                    ROUTER
                                                    RECER
                                                    RECCON
```

```
YANK
UMPIRE
TRYSHOT
TRPRNT
TOWER
TOADIL
SHRKILL
SELECT
SDIGEST
SAMATON
RONDSEE
RITER
RITEP
RITEI
READIL
BYALCOV
PLANOUT
PAGE
OUTA
NUKBLND
INRANGE
NEWMOVE
BNCONTC
MESAGE
LNPLOT
JTJ
IPJL
INTRFLY
INT2CRC
INTFIND
CRC2INT
HISTORY
GOGETEM
GNDLOOK
FUELCHK
FSDUMP
FLYSEE
FLY
FILERUP
FELDEL
ENGAGE
DOGTHNK
DOGFITE
DETECT
DESTROY
DECRALO
CRCTRAK
CRCKIL
CRCEVNT
COMMAND
CLIST
CHKCOV
CANCALO
BYPONTM
BYPONRS
```

BYPONRL
BYNOTRD
BYCONHD
BYCMDPR
BTRYTNK
BTN2CRC
BTNASIN
BOCTINK
BNPONFD
BNPONFA
BNPONBD
BNPONBB
BNNOTRD
BNCONHD
INTASIN
ATKASES
AMMOCHK
ALLOPAT
ALLOFU
ALLOBAT
AIRTHNK
ACCEPT
ABSEE
AB2CRC

15. OUTCR. CALLED BY:
CLIST2
ISDUMP
ADUMP
ROUTER
RECER
SELECT
FSDUMP
CLIST

16. QINTRY. CALLED BY:
MADEM

17. RANDOM. CALLED BY:
UMPIRE
SHRKILL
SDIGEST
SCHEDUL
PTRAND
NEWMOVE
GNOLOOK
FILERUP
DOGFITE
DETECT
CRCTRAK
CRCEVNT
CANDTGT
ATTACK
AIRTHNK

18. REWIND. CALLED BY:
HOLD

19. SIN. CALLED BY:
TXY2HXL
TGTHEX
FLITE
FIRECHK
CORBOUN
AZILIM

20. SORT. CALLED BY:
UMPIRE
TGTHEX
TRKCHEK
INRANGE
BYTKCHK
LOSRADR
FIRECHK
AZILIM

21. STOP. CALLED BY:
HALT
YANK
UNSTAT
KILFLIT
JTJ
ACCEPT

22. TAN. CALLED BY:
INSECT

23. TAPE6# CALLED BY:
CLIST2
EXITP
ENTRYP
ENTSTAT
ROUTER
RECER
RECCON
YANK
UMPIRE
TRYSHOT
TRPRNT
TOWER
TOADIL
SHRKILL
SELECT
SOIGEST
SAMATON
RONDSEE
RITER
RITEP
RITEI

```
READIL
BYALCOV
PAGE
OUTA
NUKBLNO
INRANGE
NEWMOVE
BNCONTC
MESAGE
LNPLOT
JTJ
IPJL
INTRFLY
INT2CRC
INTFINO
CRC2INT
HISTORY
GOGETEM
GNOLOOK
FUELCHK
FSDUMP
FLYSEE
FLY
FILERUP
FELDEL
ENGAGE
DOGTHNK
DOGFITE
DETECT
DESTROY
DECRALO
CRCTRAK
CRCKIL
CRCEVNT
COMMAND
CLIST
CHKCOV
CANCALO
BYPONTM
BYPONRS
BYPONRL
BYNOTRD
BYCONHD
BYCMOPR
BTRYTNK
BTN2CRC
BTNASIN
BOCTINK
BNPONFD
BNPONFA
BNPONBD
BNPONBB
BNNOTRD
BNCONHD
INTASIN
```

ATKASES
AMMOCHK
ALLOPAT
ALLOFU
ALLOBAT
AIRTHNK
ACCEPT
ABSEE
AB2CRC

24. XTOI.

CALLED BY:

UMPIRE
TXY2HXL
TERMACQ
INITACQ
HEXMOVE

```
00001      1. MADEM
00002         2  QINTRY.
00003         2. RECCON
00004            3. TAPE6#
00005            3. OUTCI.
00006            3. ADUMP
00007               4. OUTCI.
00008               4. OUTCR.
00009            3. HALT
00010               4. HOLD
00011                  5. ENTRYP
00012                     6. MESAGE
00013                        7. TAPE5#
00014                        7. OUTCI.
00015                     6. RITEI
00016                        7. TAPE6#
00017                        7. OUTCI.
00018                     6. RECER
00019                        7. TAPE5#
00020                        7. OUTCI.
00021                        7. OUTCR.
00022                     6. TAPE6#
00023                     6. OUTCI.
00024                     6. ROUTER
00025                        7. TAPE5#
00026                        7. OUTCI.
00027                        7. OUTCR.
00028                     6. ITRAP
00029                        7. HALT          (SEE LINE 00009)
00030                     6. SECOND
00031                  5. OUTBI.
00032                  5. REWIND.
00033                  5. EXITP
00034                     6. SECOND
00035                     6. MESAGE       (SEE LINE 00012)
00036                     6. RITEI        (SEE LINE 00015)
00037                     6. RECER        (SEE LINE 00018)
00038                     6. TAPE6#
00039                     6. OUTCI.
00040                     6. ITRAP        (SEE LINE 00028)
00041                     6. ICHECK
00042                        7. OUTCI.
00043               4. OUTCI.
00044               4. RITER
00045                  5. TAPE6#
00046                  5. OUTCI.
00047               4. RITEI        (SEE LINE 00015)
00048               4. TRACE
00049                  5. TRPRRT
00050                  5. TRPRMT
00051                  5. TRPRNT
00052                     6. TAPE6#
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00053                 6. OUTCI.
00054             4. RECER          (SEE LINE 00018)
00055             4. ENTSTAT
00056               5. TAPE6#
00057               5. OUTCI.
00058             4. CLIST
00059               5. PAGE
00060                 6. TAPE6#
00061                 6. OUTCI.
00062               5. LNPLOT
00063                 6. TAPE6#
00064                 6. OUTCI.
00065               5. MESAGE         (SEE LINE 00012)
00066               5. RITEP
00067                 6. LCMLOC
00068                 6. TAPE6#
00069                 6. OUTCI.
00070               5. RITER          (SEE LINE 00044)
00071               5. RITEI          (SEE LINE 00015)
00072               5. TAPE6#
00073               5. OUTCI.
00074               5. OUTCR.
00075               5. CLIST2
00076                 6. PAGE           (SEE LINE 00059)
00077                 6. LNPLOT         (SEE LINE 00062)
00078                 6. MESAGE         (SEE LINE 00012)
00079                 6. RITEI          (SEE LINE 00015)
00080                 6. RITER          (SEE LINE 00044)
00081                 6. TAPE6#
00082                 6. OUTCI.
00083                 6. OUTCR.
00084                 6. RITEP          (SEE LINE 00066)
00085             4. PAGE           (SEE LINE 00059)
00086             4. ADUMP          (SEE LINE 00006)
00087             4. ISDUMP
00088               5. OUTCI.
00089               5. OUTCR.
00090             4. ENDFIL.
00091             4. STOP.
00092         2. ENTRYP         (SEE LINE 00011)
00093         2. INPFI.
00094         2. DBGREAD
00095           3. OUTCI.
00096           3. INPCI.
00097           3. EOF
00098           3. DECODI.
00099         2. RECOVR
00100         2. GOTOER.
00101         2. FETCH
00102           3. ENTRYP         (SEE LINE 00011)
00103           3. INPBI.
00104           3. EXITP          (SEE LINE 00033)
00105         2. PAGE           (SEE LINE 00059)
00106         2. LCMLOC
00107         2. FSINIT
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00108         2. OTHRDAT
00109         2. DISPDAT
00110            3. OUTCI.
00111            3. DISPADS
00112               4. OUTCI.
00113            3. DISPFDB
00114               4. OUTCI.
00115               4. DISPFMF
00116                  5. OUTCI.
00117                  5. DISPFLT
00118                     6. OUTCI.
00119                     6. DISPPAY
00120                        7. OUTCI.
00121                        7. DISPPYB
00122                           8. OUTCI.
00123                     6. DISPAQD
00124                        7. OUTCI.
00125                     6. DISPACD
00126                        7. OUTCI.
00127                     6. DISPPRO
00128                        7. OUTCI.
00129            3. DISPFLT      (SEE LINE 00117)
00130            3. DISPACD      (SEE LINE 00125)
00131            3. DISPPAF
00132               4. OUTCI.
00133               4. DISPPYB      (SEE LINE 00121)
00134            3. DISPPRO      (SEE LINE 00127)
00135            3. DISPAQD      (SEE LINE 00123)
00136            3. DISPABQ
00137               4. OUTCI.
00138            3. DISPACR
00139               4. OUTCI.
00140               4. DISPACL
00141                  5. OUTCI.
00142         2. HALT         (SEE LINE 00009)
00143         2. INIT
00144         2. LRKPRS
00145         2. RELIST
00146            3. ENTRYP       (SEE LINE 00011)
00147            3. RELEASE
00148               4. ENTRYP       (SEE LINE 00011)
00149               4. MESAGE       (SEE LINE 00012)
00150               4. RITEI        (SEE LINE 00015)
00151               4. RITEP        (SEE LINE 00066)
00152               4. HALT         (SEE LINE 00009)
00153               4. GIMME
00154                  5. ENTRYP       (SEE LINE 00011)
00155                  5. HALT         (SEE LINE 00009)
00156                  5. MESAGE       (SEE LINE 00012)
00157                  5. RITEI        (SEE LINE 00015)
00158                  5. RITEP        (SEE LINE 00066)
00159                  5. EXITP        (SEE LINE 00033)
00160               4. EXITP        (SEE LINE 00033)
00161            3. EXITP        (SEE LINE 00033)
00162         2. DELADD
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00163           3. ENTRYP      (SEE LINE 00011)
00164           3. MESAGE      (SEE LINE 00012)
00165           3. TRACE       (SEE LINE 00048)
00166           3. RECER       (SEE LINE 00018)
00167           3. GIMME       (SEE LINE 00153)
00168           3. SNAP
00169              4. ENTRYP      (SEE LINE 00011)
00170              4. EXITP       (SEE LINE 00033)
00171           3. LTRMRG
00172              4. ENTRYP      (SEE LINE 00011)
00173              4. EXITP       (SEE LINE 00033)
00174           3. EXITP       (SEE LINE 00033)
00175        2. CONTROL
00176           3. ENTRYP      (SEE LINE 00011)
00177           3. LTREE
00178              4. ENTRYP      (SEE LINE 00011)
00179              4. RELEASE     (SEE LINE 00147)
00180              4. LTRMRG      (SEE LINE 00171)
00181              4. EXITP       (SEE LINE 00033)
00182           3. SELECT
00183              4. ENTRYP      (SEE LINE 00011)
00184              4. GOTOER.
00185              4. MESAGE      (SEE LINE 00012)
00186              4. RITEI       (SEE LINE 00015)
00187              4. HALT        (SEE LINE 00009)
00188              4. FELDEL
00189                 5. UNPACK
00190                    6. ENTRYP      (SEE LINE 00011)
00191                    6. LCMLOC
00192                    6. RITEP       (SEE LINE 00066)
00193                    6. ISDUMP      (SEE LINE 00087)
00194                    6. HALT        (SEE LINE 00009)
00195                    6. EXITP       (SEE LINE 00033)
00196                 5. UNSNAP
00197                    6. ENTRYP      (SEE LINE 00011)
00198                    6. EXITP       (SEE LINE 00033)
00199                 5. RELEASE     (SEE LINE 00147)
00200                 5. TAPE6#
00201                 5. OUTCI.
00202                 ASSIGN
00203                 5. GETPTRS
00204                    6. ENTRYP      (SEE LINE 00011)
00205                    6. EXITP       (SEE LINE 00033)
00206                 5. INTASIN
00207                    6. FINDBLK
00208                       7. ENTRYP      (SEE LINE 00011)
00209                       7. ROUTER      (SEE LINE 00024)
00210                       7. MESAGE      (SEE LINE 00012)
00211                       7. RITEI       (SEE LINE 00015)
00212                       7. CLIST       (SEE LINE 00058)
00213                       7. EXITP       (SEE LINE 00033)
00214                    6. TRACE       (SEE LINE 00048)
00215                    6. MESAGE      (SEE LINE 00012)
00216                    6. RITEI       (SEE LINE 00015)
00217                    6. CLIST       (SEE LINE 00058)
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00218          6. UNPACK        (SEE LINE 00189)
00219          6. HEXDIST
00220          6. TGTHEX
00221             7. TRACE         (SEE LINE 00048)
00222             7. MESAGE        (SEE LINE 00012)
00223             7. RITEI         (SEE LINE 00015)
00224             7. CLIST         (SEE LINE 00058)
00225             7. UNPACK        (SEE LINE 00189)
00226             7. THH2PS
00227                8. ENTRYP        (SEE LINE 00011)
00228                8. THX2XY
00229                   9. ENTRYP        (SEE LINE 00011)
00230                   9. HXDGTS
00231                     10. ENTRYP        (SEE LINE 00011)
00232                     10. EXITP         (SEE LINE 00033)
00233                   9. JUGGLE
00234                     10. ENTRYP        (SEE LINE 00011)
00235                     10. EXITP         (SEE LINE 00033)
00236                   9. EXITP         (SEE LINE 00033)
00237                8. EXITP         (SEE LINE 00033)
00238             7. ATAN2.
00239             7. COS.
00240             7. SQRT.
00241             7. SIN.
00242             7. TXY2HXL
00243                8. ENTRYP        (SEE LINE 00011)
00244                8. COS.
00245                8. SIN.
00246                8. XTOI.
00247                8. CENTER
00248                   9. ENTRYP        (SEE LINE 00011)
00249                   9. EXITP         (SEE LINE 00033)
00250                8. IJ2HX
00251                   9. HEXMLT
00252                     10. HEXADD
00253                        11. ENTRYP        (SEE LINE 00011)
00254                        11. ITOJ.
00255                        11. EXITP         (SEE LINE 00033)
00256                     10. ENTRYP        (SEE LINE 00011)
00257                     10. HXDGTS        (SEE LINE 00230)
00258                     10. MESAGE        (SEE LINE 00012)
00259                     10. RITEI         (SEE LINE 00015)
00260                     10. EXITP         (SEE LINE 00033)
00261                   9. ENTRYP        (SEE LINE 00011)
00262                   9. ITOJ.
00263                   9. EXITP         (SEE LINE 00033)
00264                8. GETHEX
00265                   9. ENTRYP        (SEE LINE 00011)
00266                   9. HXDGTS        (SEE LINE 00230)
00267                   9. MESAGE        (SEE LINE 00012)
00268                   9. RITEI         (SEE LINE 00015)
00269                   9. GIMME         (SEE LINE 00153)
00270                   9. SCHTAB
00271                     10. ENTRYP        (SEE LINE 00011)
00272                     10. EXITP         (SEE LINE 00033)
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00273                         9. EXITP        (SEE LINE 00033)
00274                      8. EXITP        (SEE LINE 00033)
00275                6. MESBILD
00276                   7. GIMME        (SEE LINE 00153)
00277                   7. PACK
00278                      8. ENTRYP       (SEE LINE 00011)
00279                      8. LCMLOC
00280                      8. PAGE         (SEE LINE 00059)
00281                      8. MESAGE       (SEE LINE 00012)
00282                      8. RITEI        (SEE LINE 00015)
00283                      8. TRACEP       (SEE LINE 00048)
00284                      8. ROUTER       (SEE LINE 00024)
00285                      8. RITEP        (SEE LINE 00066)
00286                      8. ISDUMP       (SEE LINE 00087)
00287                      8. HALT         (SEE LINE 00009)
00288                      8. EXITP        (SEE LINE 00033)
00289                6. PACK         (SEE LINE 00277)
00290                6. DELADD       (SEE LINE 00162)
00291                6. TAPE6#
00292                6. OUTCI.
00293                6. BTNASIN
00294                   7. UNPACK       (SEE LINE 00189)
00295                   7. FINDBLK      (SEE LINE 00207)
00296                   7. PACK         (SEE LINE 00277)
00297                   7. HEXDIST
00298                   7. RELEASE      (SEE LINE 00147)
00299                   7. DROPBLK
00300                      8. ENTRYP       (SEE LINE 00011)
00301                      8. RELEASE      (SEE LINE 00147)
00302                      8. EXITP        (SEE LINE 00033)
00303                   7. MESBILD      (SEE LINE 00275)
00304                   7. DELADD       (SEE LINE 00162)
00305                   7. TAPES#
00306                   7. OUTCI.
00307          4. ATTACK
00308             5. GETPTRS      (SEE LINE 00203)
00309             5. UNSTAT
00310                6. TRACE        (SEE LINE 00048)
00311                6. MESAGE       (SEE LINE 00012)
00312                6. CLIST        (SEE LINE 00058)
00313                6. FSDUMP
00314                   7. ENTRYP       (SEE LINE 00011)
00315                   7. TRACE        (SEE LINE 00048)
00316                   7. ENTSTAT      (SEE LINE 00055)
00317                   7. CLIST        (SEE LINE 00058)
00318                   7. RITER        (SEE LINE 00044)
00319                   7. LNPLOT       (SEE LINE 00062)
00320                   7. LCMLOC
00321                   7. TAPES#
00322                   7. OUTCI.
00323                   7. OUTCR.
00324                   7. EXITP        (SEE LINE 00033)
00325                6. STOP.
00326                6. UNPACK       (SEE LINE 00189)
00327             5. SHRKILL
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00328                6. ALOG.
00329                6. RANDOM.
00330                6. HISTORY
00331                   7. ENTRYP       (SEE LINE 00011)
00332                   7. MESAGE       (SEE LINE 00012)
00333                   7. MASKER
00334                   7. TAPE5#
00335                   7. OUTCI.
00336                   7. EXITP        (SEE LINE 00033)
00337                6. UNPACK       (SEE LINE 00189)
00338                6. TAPE6#
00339                6. OUTCI.
00340                6. GIMME        (SEE LINE 00153)
00341                6. PACK         (SEE LINE 00277)
00342                6. DELADD       (SEE LINE 00162)
00343                6. DESTROY
00344                   7. TAPE5#
00345                   7. OUTCI.
00346                   7. GETPTRS      (SEE LINE 00203)
00347                   7. TERMACQ
00348                      8. UNPACK       (SEE LINE 00189)
00349                      8. XTOI.
00350                      8. NO#UCIT
00351                         9. ENTRYP       (SEE LINE 00011)
00352                         9. HEXADD       (SEE LINE 00252)
00353                         9. HEXMULT
00354                           10. ENTRYP       (SEE LINE 00011)
00355                           10. ITOJ.
00356                           10. EXITP        (SEE LINE 00033)
00357                         9. GETHEX       (SEE LINE 00264)
00358                         9. GIMME        (SEE LINE 00153)
00359                         9. ADDBLOK
00360                           10. ENTRYP       (SEE LINE 00011)
00361                           10. EXITP        (SEE LINE 00033)
00362                         9. FINDBLK      (SEE LINE 00207)
00363                         9. DROPBLK      (SEE LINE 00299)
00364                         9. RELEASE      (SEE LINE 00147)
00365                         9. EXITP        (SEE LINE 00033)
00366                      8. RELEASE      (SEE LINE 00147)
00367                   7. KILFLIT
00368                      8. GIMME        (SEE LINE 00153)
00369                      8. DELADD       (SEE LINE 00162)
00370                      8. STOP.
00371                      8. UNPACK       (SEE LINE 00189)
00372                      8. RELEASE      (SEE LINE 00147)
00373                      8. UNSTAT       (SEE LINE 00309)
00374                      8. FLTYPE
00375                         9. UNPACK       (SEE LINE 00189)
00376                         9. RELEASE      (SEE LINE 00147)
00377                         9. FINDBLK      (SEE LINE 00207)
00378                         9. TRACE        (SEE LINE 00048)
00379                         9. MESAGE       (SEE LINE 00012)
00380                         9. RITEI        (SEE LINE 00015)
00381                         9. CLIST        (SEE LINE 00058)
00382                         9. FSDUMP       (SEE LINE 00313)
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00383               9. DROPBLK      (SEE LINE 00299)
00384               9. PACK         (SEE LINE 00277)
00385             8. FINDBLK      (SEE LINE 00207)
00386             8. DROPBLK      (SEE LINE 00299)
00387           7. GIMME        (SEE LINE 00153)
00388           7. DELADD       (SEE LINE 00162)
00389           7. SAMWYPE
00390             8. UNPACK       (SEE LINE 00189)
00391             8. GIMME        (SEE LINE 00153)
00392             8. DELADD       (SEE LINE 00162)
00393             8. GOTOER.
00394             8. RELEASE      (SEE LINE 00147)
00395             8. BYENDPS
00396               9. SEEKP
00397               9. UNPACK       (SEE LINE 00189)
00398               9. YANK
00399                 10. UNPACK       (SEE LINE 00189)
00400                 10. TAPE6#
00401                 10. OUTCI.
00402                 10. TRACE        (SEE LINE 00048)
00403                 10. OUTA
00404                   11. ENTRYP       (SEE LINE 00011)
00405                   11. TAPE6#
00406                   11. OUTCI.
00407                   11. EXITP        (SEE LINE 00033)
00408                 10. FSDUMP       (SEE LINE 00313)
00409                 10. STOP.
00410                 10. PACK         (SEE LINE 00277)
00411               9. RELEASE      (SEE LINE 00147)
00412               9. GETPTRS      (SEE LINE 00203)
00413               9. CRCLOSS
00414                 10. FINDBLK      (SEE LINE 00207)
00415                 10. UNPACK       (SEE LINE 00189)
00416                 10. DROPBLK      (SEE LINE 00299)
00417                 10. DELADD       (SEE LINE 00162)
00418               9. BNLALLE
00419                 10. MESBILD      (SEE LINE 00275)
00420                 10. DELADD       (SEE LINE 00162)
00421                 10. YANK         (SEE LINE 00398)
00422                 10. HANDZPT
00423                   11. BATCEAS
00424                     12. CANCALD
00425                       13. YANK         (SEE LINE 00398)
00426                       13. RELEASE      (SEE LINE 00147)
00427                       13. TAPE6#
00428                       13. OUTCI.
00429                       13. READIL
00430                         14. UNPACK       (SEE LINE 0018
00431                         14. YANK         (SEE LINE 0039
00432                         14. STICK
00433                           15. UNPACK       (SEE LINE 0
00434                           15. PACK         (SEE LINE 0
00435                         14. TAPE6#
00436                         14. OUTCI.
00437                         14. RELOCAT
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00438                              15. YANK          (SEE LINE 0
00439                              15. STICK         (SEE LINE 0
00440                           14. DELADD        (SEE LINE 0016
00441                     12. GIMME       (SEE LINE 00153)
00442                     12. UNPACK      (SEE LINE 00189)
00443                     12. SEEKTFU
00444                        13. TRKCHEK
00445                           14. THH2PS        (SEE LINE 0022
00446                           14. SQRT.
00447                           14. ATAN2.
00448                           14. YANK          (SEE LINE 0039
00449                           14. MESAGE        (SEE LINE 0001
00450                           14. RITEI         (SEE LINE 0001
00451                           14. CLIST         (SEE LINE 0005
00452                           14. FSDUMP        (SEE LINE 0031
00453                           14. STICK         (SEE LINE 0043
00454                           14. TOADIL
00455                              15. TAPE6#
00456                              15. OUTCI.
00457                              15. YANK          (SEE LINE 0
00458                              15. STICK         (SEE LINE 0
00459                              15. RELOCAT       (SEE LINE 0
00460                              15. GIMME         (SEE LINE 0
00461                           14. BNLALLE       (SEE LINE 0041
00462                        13. ALLOFU
00463                           14. GIMME         (SEE LINE 0015
00464                           14. STICK         (SEE LINE 0043
00465                           14. DELADD        (SEE LINE 0016
00466                           14. TAPE6#
00467                           14. *OUTCI.
00468                        13. ALLOPAT
00469                           14. GIMME         (SEE LINE 0015
00470                           14. STICK         (SEE LINE 0043
00471                           14. DELADD        (SEE LINE 0016
00472                           14. TAPE6#
00473                           14. OUTCI.
00474                     12. STICK       (SEE LINE 00432)
00475                     12. RELEASE     (SEE LINE 00147)
00476                  11. YANK        (SEE LINE 00398)
00477                  11. STICK       (SEE LINE 00432)
00478                  11. TOADIL      (SEE LINE 00454)
00479                  11. RELOCAT     (SEE LINE 00437)
00480                  11. DILOUT
00481                     12. CNACTTK
00482                        13. YANK        (SEE LINE 00398)
00483                        13. RELEASE     (SEE LINE 00147)
00484                     12. RELEASE     (SEE LINE 00147)
00485                     12. UNPACK      (SEE LINE 00189)
00486                     12. YANK        (SEE LINE 00398)
00487                     12. TOADIL      (SEE LINE 00454)
00488               10. DILOUT      (SEE LINE 00480)
00489               10. STICK       (SEE LINE 00432)
00490          8. FINDBLK     (SEE LINE 00207)
00491          8. DROPBLK     (SEE LINE 00299)
00492       7. CRCDIES
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00493                         8. UNPACK      (SEE LINE 00189)
00494                         8. RELEASE     (SEE LINE 00147)
00495                         8. DELADD      (SEE LINE 00162)
00496                         8. FINDBLK     (SEE LINE 00207)
00497                         8. TRACEI      (SEE LINE 00048)
00498                         8. MESAGE      (SEE LINE 00012)
00499                         8. RITEI       (SEE LINE 00015)
00500                         8. CLIST       (SEE LINE 00058)
00501                         8. DROPBLK     (SEE LINE 00299)
00502                      7. UNLINK
00503                         8. UNPACK      (SEE LINE 00189)
00504                      7. RELEASE     (SEE LINE 00147)
00505                      7. UNSTAT      (SEE LINE 00309)
00506                5. FINDBLK     (SEE LINE 00207)
00507                5. XPK
00508                5. RANDOM.
00509                5. NUKBLNO
00510                   6. UNPACK      (SEE LINE 00189)
00511                   6. GIMME       (SEE LINE 00153)
00512                   6. HEXADD      (SEE LINE 00252)
00513                   6. GETHEX      (SEE LINE 00264)
00514                   6. TAPE6#
00515                   6. OUTCI.
00516                   6. DELADD      (SEE LINE 00162)
00517                   6. SAMWYPE     (SEE LINE 00389)
00518                   6. TERMACQ     (SEE LINE 00347)
00519                   6. FINDBLK     (SEE LINE 00207)
00520                   6. RELEASE     (SEE LINE 00147)
00521                   6. DROPBLK     (SEE LINE 00299)
00522                   6. UNLINK      (SEE LINE 00502)
00523                5. DROPBLK     (SEE LINE 00299)
00524                5. HISTORY     (SEE LINE 00330)
00525                5. DELADD      (SEE LINE 00162)
00526                5. STATPAK
00527             4. COMMO
00528                5. UNPACK      (SEE LINE 00189)
00529                5. DELADD      (SEE LINE 00162)
00530                5. RELEASE     (SEE LINE 00147)
00531                5. PACK        (SEE LINE 00277)
00532             4. DOGFITE
00533                5. GETPTRS     (SEE LINE 00203)
00534                5. UNSTAT      (SEE LINE 00309)
00535                5. TAPE6#
00536                5. OUTCI.
00537                5. HISTORY     (SEE LINE 00330)
00538                5. FINDBLK     (SEE LINE 00207)
00539                5. DROPBLK     (SEE LINE 00299)
00540                5. DELADD      (SEE LINE 00162)
00541                5. XPAA
00542                5. RANDOM.
00543                5. GIMME       (SEE LINE 00153)
00544                5. DESTROY     (SEE LINE 00343)
00545             4. ENGAGE
00546                5. GETPTRS     (SEE LINE 00203)
00547                5. TRYSHOT
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00548              6. GOTOER.
00549              6. TAPE6#
00550              6. OUTCI.
00551              6. YANK        (SEE LINE 00398)
00552              6. BATCEAS     (SEE LINE 00423)
00553              6. BNLALLE     (SEE LINE 00418)
00554              6. FIRECHK
00555                 7. THX2XY      (SEE LINE 00228)
00556                 7. SIN.
00557                 7. COS.
00558                 7. SQRT.
00559                 7. ATAN2.
00560                 7. ASIN.
00561           5. TAPE6#
00562           5. OUTCI.
00563           5. GIMME        (SEE LINE 00153)
00564           5. DELADD       (SEE LINE 00162)
00565           5. UNPACK       (SEE LINE 00189)
00566           5. PACK         (SEE LINE 00277)
00567           5. AMMOCHK
00568              6. MESBILD     (SEE LINE 00275)
00569              6. DELADD      (SEE LINE 00162)
00570              6. GOTOER.
00571              6. BYNOTRD
00572                 7. UNPACK      (SEE LINE 00189)
00573                 7. BATCEAS     (SEE LINE 00423)
00574                 7. OILOJT      (SEE LINE 00480)
00575                 7. TAPE6#
00576                 7. OUTCI.
00577              6. TAPE6#
00578              6. OUTCI.
00579           5. RELEASE      (SEE LINE 00147)
00580           5. HISTORY      (SEE LINE 00330)
00581        4. FLY
00582           5. GETPTRS      (SEE LINE 00203)
00583           5. UNSTAT       (SEE LINE 00309)
00584           5. HEXMOVE
00585              6. TRACE       (SEE LINE 00048)
00586              6. MESAGE      (SEE LINE 00012)
00587              6. RITEI       (SEE LINE 00015)
00588              6. CLIST       (SEE LINE 00058)
00589              6. UNPACK      (SEE LINE 00189)
00590              6. XTOI.
00591              6. NOWUCIT     (SEE LINE 00350)
00592              6. FINDBLK     (SEE LINE 00207)
00593              6. DROPBLK     (SEE LINE 00299)
00594              6. RELEASE     (SEE LINE 00147)
00595              6. PACK        (SEE LINE 00277)
00596              6. UOLLOAD
00597                 7. ENTRYP      (SEE LINE 00011)
00598                 7. GIMME       (SEE LINE 00153)
00599                 7. ADDBLOK     (SEE LINE 00359)
00600                 7. EXITP       (SEE LINE 00033)
00601           5. FUELCHK
00602              6. UNPACK      (SEE LINE 00189)
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00603                 6. HEXDIST
00604                 6. GOTOAB
00605                    7. UNPACK       (SEE LINE 00189)
00606                    7. FLTWYPE      (SEE LINE 00374)
00607                    7. OPTPTH
00608                       8. GIMMEI       (SEE LINE 00153)
00609                       8. THH2PS       (SEE LINE 00226)
00610                       8. HEXCHZ
00611                          9. ENTRYP       (SEE LINE 00011)
00612                          9. TRACE        (SEE LINE 00048)
00613                          9. MESAGE       (SEE LINE 00012)
00614                          9. RITEP        (SEE LINE 00066)
00615                          9. CLIST        (SEE LINE 00058)
00616                          9. HEXADD       (SEE LINE 00252)
00617                          9. HEXINV
00618                            10. ENTRYP       (SEE LINE 00011)
00619                            10. ITOJ.
00620                            10. EXITP        (SEE LINE 00033)
00621                          9. GETHEX       (SEE LINE 00264)
00622                          9. EXITP        (SEE LINE 00033)
00623                       8. LINEX
00624                          9. ENTRYP       (SEE LINE 00011)
00625                          9. EXITP        (SEE LINE 00033)
00626                       8. PACK         (SEE LINE 00277)
00627                    7. RELEASE      (SEE LINE 00147)
00628                    7. THH2PS       (SEE LINE 00226)
00629                    7. ATAN2.
00630                 6. TAPE6#
00631                 6. OUTCI.
00632                 6. MESBILD      (SEE LINE 00275)
00633                 6. DELADD       (SEE LINE 00162)
00634              5. SHRKILL      (SEE LINE 00327)
00635              5. FLITE
00636                 6. INTRFLY
00637                    7. TGTHEX       (SEE LINE 00220)
00638                    7. HEXDIST
00639                    7. MESBILD      (SEE LINE 00275)
00640                    7. DELADD       (SEE LINE 00162)
00641                    7. TAPE5#
00642                    7. OUTCI.
00643                    7. UNPACK       (SEE LINE 00189)
00644                    7. THH2PS       (SEE LINE 00226)
00645                    7. ATAN2.
00646                    7. OPTPTH       (SEE LINE 00607)
00647                    7. RELEASE      (SEE LINE 00147)
00648                 6. UNPACK       (SEE LINE 00189)
00649                 6. COMMAND
00650                    7. UNPACK       (SEE LINE 00189)
00651                    7. GOTOER.
00652                    7. DELADD       (SEE LINE 00162)
00653                    7. TAPE5#
00654                    7. OUTCI.
00655                    7. MESBILD      (SEE LINE 00275)
00656                    7. FLTWYPE      (SEE LINE 00374)
00657                    7. THH2PS       (SEE LINE 00226)
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00658                 7. ATAN2.
00659               6. HEXCHZ        (SEE LINE 00610)
00660               6. OPTPTH        (SEE LINE 00607)
00661               6. RELEASE       (SEE LINE 00147)
00662               6. SIN.
00663               6. DELADD        (SEE LINE 00162)
00664             5. DELADD        (SEE LINE 00162)
00665             5. STATPAK
00666             5. GIMME         (SEE LINE 00153)
00667             5. PACK          (SEE LINE 00277)
00668             5. TAPE6#
00669             5. OUTCI.
00670             5. DESTROY       (SEE LINE 00343)
00671           4. NAYBOR
00672             5. UNPACK        (SEE LINE 00189)
00673             5. MESAGE        (SEE LINE 00012)
00674             5. RITEI         (SEE LINE 00015)
00675             5. TRACE         (SEE LINE 00048)
00676             5. CLIST         (SEE LINE 00058)
00677             5. HEXDIST
00678             5. GIMME         (SEE LINE 00153)
00679             5. DELADD        (SEE LINE 00162)
00680             5. RELEASE       (SEE LINE 00147)
00681           4. PERCEPT
00682             5. GETPTRS       (SEE LINE 00203)
00683             5. ABSEE
00684               6. UNPACK        (SEE LINE 00189)
00685               6. DELADD        (SEE LINE 00162)
00686               6. RELEASE       (SEE LINE 00147)
00687               6. TAPE6#
00688               6. OUTCI.
00689             5. CFLYCRC
00690               6. CRCSEE
00691                 7. RELEASE       (SEE LINE 00147)
00692                 7. GIMME         (SEE LINE 00153)
00693                 7. UNPACK        (SEE LINE 00189)
00694                 7. DELADD        (SEE LINE 00162)
00695                 7. CRCEVNT
00696                   8. GIMME         (SEE LINE 00153)
00697                   8. TAPE6#
00698                   8. OUTCI.
00699                   8. DELADD        (SEE LINE 00162)
00700                   8. RELEASE       (SEE LINE 00147)
00701                   8. FINDBLK       (SEE LINE 00207)
00702                   8. DETECT
00703                     9. HEXDIST
00704                     9. UNPACK        (SEE LINE 00189)
00705                     9. THH2PS        (SEE LINE 00226)
00706                     9. ATAN2.
00707                     9. LOGRADR
00708                      10. ISHIFT
00709                      10. OPTPTH        (SEE LINE 00607)
00710                      10. THH2PS        (SEE LINE 00226)
00711                      10. SQRT.
00712                      10. COS.
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00713                          10. UNPACK      (SEE LINE 00189)
00714                          10. RELEASE     (SEE LINE 00147)
00715                        9. COS.
00716                        9. RANDOM.
00717                        9. TAPE6#
00718                        9. OUTCI.
00719                    8. UNPACK      (SEE LINE 00189)
00720                    8. HEXDIST
00721                    8. LOSRADR     (SEE LINE 00707)
00722                    8. COS.
00723                    8. RANDOM.
00724                    8. CRCTRAK
00725                      9. FINDBLK     (SEE LINE 00207)
00726                      9. UNPACK      (SEE LINE 00189)
00727                      9. MESBILD     (SEE LINE 00275)
00728                      9. DELADD      (SEE LINE 00162)
00729                      9. TAPE6#
00730                      9. OUTCI.
00731                      9. CRCKIL
00732                        10. FINDBLK     (SEE LINE 00207)
00733                        10. UNPACK      (SEE LINE 00189)
00734                        10. RELEASE     (SEE LINE 00147)
00735                        10. DROPBLK     (SEE LINE 00299)
00736                        10. TAPE6#
00737                        10. OUTCI.
00738                        10. DELADD      (SEE LINE 00162)
00739                      9. BADMOVE
00740                        10. FINDBLK     (SEE LINE 00207)
00741                        10. GIMME       (SEE LINE 00153)
00742                        10. ADDBLOK     (SEE LINE 00359)
00743                        10. HISTORY     (SEE LINE 00330)
00744                        10. UNPACK      (SEE LINE 00189)
00745                        10. RELEASE     (SEE LINE 00147)
00746                        10. DROPBLK     (SEE LINE 00299)
00747                        10. TGTHEX      (SEE LINE 00220)
00748                        10. HEXDIST
00749                        10. MESBILD     (SEE LINE 00275)
00750                        10. DELADD      (SEE LINE 00162)
00751                      9. DROPBLK     (SEE LINE 00299)
00752                      9. RANDOM.
00753                      9. NEWMOVE
00754                        10. FINDBLK     (SEE LINE 00207)
00755                        10. RANDOM.
00756                        10. TAPE6#
00757                        10. OUTCI.
00758                        10. GIMME       (SEE LINE 00153)
00759                        10. ADDBLOK     (SEE LINE 00359)
00760                        10. HISTORY     (SEE LINE 00330)
00761                        10. DELADD      (SEE LINE 00162)
00762              6. UNSTAT      (SEE LINE 00309)
00763              6. FLYSEE
00764                7. DELADD      (SEE LINE 00162)
00765                7. GIMME       (SEE LINE 00153)
00766                7. ADDBLOK     (SEE LINE 00359)
00767                7. TAPE6#
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00768            7. OUTCI.
00769            7. MESBILD      (SEE LINE 00275)
00770            7. RELEASE      (SEE LINE 00147)
00771            7. HEXDIST
00772            7. DETECT       (SEE LINE 00702)
00773            7. HISTORY      (SEE LINE 00330)
00774         6. ATKASES
00775            7. GIMME        (SEE LINE 00153)
00776            7. DELADD       (SEE LINE 00162)
00777            7. DESTROY      (SEE LINE 00343)
00778            7. TAPES#
00779            7. OUTCI.
00780            7. ADDBLOK      (SEE LINE 00359)
00781            7. THH2PS       (SEE LINE 00226)
00782            7. ATAN2.
00783         6. CRC2INT
00784            7. UNPACK       (SEE LINE 00189)
00785            7. TAPES#
00786            7. OUTCI.
00787            7. MESBILD      (SEE LINE 00275)
00788            7. DELADD       (SEE LINE 00162)
00789            7. OPTPTH       (SEE LINE 00607)
00790            7. RELEASE      (SEE LINE 00147)
00791            7. THH2PS       (SEE LINE 00226)
00792            7. ATAN2.
00793         6. RONDSEE
00794            7. UNPACK       (SEE LINE 00189)
00795            7. OPTPTH       (SEE LINE 00607)
00796            7. THH2PS       (SEE LINE 00226)
00797            7. ATAN2.
00798            7. RELEASE      (SEE LINE 00147)
00799            7. TAPES#
00800            7. OUTCI.
00801            7. GETPTRS      (SEE LINE 00203)
00802            7. UNSTAT       (SEE LINE 00309)
00803            7. STATPAK
00804         6. GNDLOOK
00805            7. FINDBLK      (SEE LINE 00207)
00806            7. XPD
00807            7. RANDOM.
00808            7. DELADD       (SEE LINE 00162)
00809            7. HISTORY      (SEE LINE 00330)
00810            7. TAPES#
00811            7. OUTCI.
00812            7. UNPACK       (SEE LINE 00189)
00813            7. THH2PS       (SEE LINE 00226)
00814            7. ATAN2.
00815         6. STATPAK
00816      5. SAMSEE
00817         6. SAMPRCM
00818            7. TRACE        (SEE LINE 00048)
00819            7. MESAGE       (SEE LINE 00012)
00820            7. RITEP        (SEE LINE 00066)
00821            7. CLIST        (SEE LINE 00058)
00822            7. SEEKP
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00823                    7. DETECT       (SEE LINE 00702)
00824                    7. BYTKCHK
00825                       8. SQRT.
00826                       8. ATAN2.
00827                       8. LOSRADR      (SEE LINE 00707)
00828                       8. DELADD       (SEE LINE 00162)
00829                       8. YANK         (SEE LINE 00398)
00830                       8. STICK        (SEE LINE 00432)
00831                       8. TOADIL       (SEE LINE 00454)
00832                    7. NEWPERC
00833                       8. HISTORY      (SEE LINE 00330)
00834                       8. GIMME        (SEE LINE 00153)
00835                       8. STICK        (SEE LINE 00432)
00836                       8. DELADD       (SEE LINE 00162)
00837                    7. GETPTRS      (SEE LINE 00203)
00838                    7. CRCTRAK      (SEE LINE 00724)
00839                    7. BYPASUP
00840                       8. SEEKP
00841                       8. UNPACK       (SEE LINE 00189)
00842                       8. GIMME        (SEE LINE 00153)
00843                       8. PACK         (SEE LINE 00277)
00844                       8. NEWPERC      (SEE LINE 00832)
00845                       8. GETPTRS      (SEE LINE 00203)
00846                       8. CRCTRAK      (SEE LINE 00724)
00847                    7. BYENDPS      (SEE LINE 00395)
00848                    7. CRCLOSS      (SEE LINE 00413)
00849                    7. DROPPOS
00850                       8. YANK         (SEE LINE 00398)
00851                       8. RELEASE      (SEE LINE 00147)
00852                       8. MESBILD      (SEE LINE 00275)
00853                       8. DELADD       (SEE LINE 00162)
00854                       8. SEEKENG
00855                          9. DROPPS2
00856                            10. YANK          (SEE LINE 00398)
00857                            10. RELEASE       (SEE LINE 00147)
00858                            10. MESBILD       (SEE LINE 00275)
00859                            10. DELADD        (SEE LINE 00162)
00860                            10. SEEKENG       (SEE LINE 00854)
00861                            10. GIMME         (SEE LINE 00153)
00862                            10. OLYACT
00863                               11. UNPACK        (SEE LINE 00189)
00864                               11. PACK          (SEE LINE 00277)
00865                               11. STICK         (SEE LINE 00432)
00866                          9. GIMME        (SEE LINE 00153)
00867                          9. DELADD       (SEE LINE 00162)
00868                          9. SSLL
00869                            10. UNPACK        (SEE LINE 00189)
00870                            10. ISHIFT
00871                            10. INSERT
00872                               11. UNPACK        (SEE LINE 00189)
00873                               11. XSHIFT
00874                          9. ALLOBAT
00875                            10. PRIORTY
00876                            10. MESBILD       (SEE LINE 00275)
00877                            10. GIMME         (SEE LINE 00153)
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00878                         10. PACK         (SEE LINE 00277)
00879                         10. TAPE6#
00880                         10. OUTCI.
00881                         10. OUTA         (SEE LINE 00403)
00882                         10. DELADD       (SEE LINE 00162)
00883                         10. YANK         (SEE LINE 00398)
00884                         10. STICK        (SEE LINE 00432)
00885                         10. TOADIL       (SEE LINE 00454)
00886                      9. RELEASE      (SEE LINE 00147)
00887                  8. GIMME        (SEE LINE 00153)
00888                  8. DLYACT       (SEE LINE 00862)
00889              7. BNLALLE      (SEE LINE 00418)
00890              7. YANK         (SEE LINE 00398)
00891              7. RELEASE      (SEE LINE 00147)
00892          6. DELADD       (SEE LINE 00162)
00893          6. RELEASE      (SEE LINE 00147)
00894  4. PLAN
00895      5. ENTRYP       (SEE LINE 00011)
00896      5. GETPTRS      (SEE LINE 00203)
00897      5. THTRPLN
00898          6. ENTRYP       (SEE LINE 00011)
00899          6. CORBOUN
00900              7. ENTRYP       (SEE LINE 00011)
00901              7. GIMME        (SEE LINE 00153)
00902              7. THH2PS       (SEE LINE 00226)
00903              7. TXY2HXL      (SEE LINE 00242)
00904              7. HEXDIST
00905              7. SIN.
00906              7. COS.
00907              7. LINEX        (SEE LINE 00623)
00908              7. OPTPTH       (SEE LINE 00607)
00909              7. EXITP        (SEE LINE 00033)
00910          6. REVISE
00911              7. ENTRYP       (SEE LINE 00011)
00912              7. GIMME        (SEE LINE 00153)
00913              7. ABVSCOR
00914                  8. ENTRYP       (SEE LINE 00011)
00915                  8. CLOSCOR
00916                      9. ENTRYP       (SEE LINE 00011)
00917                      9. HEXDIST
00918                      9. EXITP        (SEE LINE 00033)
00919                  8. GIMME        (SEE LINE 00153)
00920                  8. ADDBLOK      (SEE LINE 00359)
00921                  8. EXITP        (SEE LINE 00033)
00922              7. RELEASE      (SEE LINE 00147)
00923              7. EXITP        (SEE LINE 00033)
00924          6. FINDBLK      (SEE LINE 00207)
00925          6. KOMPARE
00926              7. ENTRYP       (SEE LINE 00011)
00927              7. UNPACK       (SEE LINE 00189)
00928              7. PACK         (SEE LINE 00277)
00929              7. EXITP        (SEE LINE 00033)
00930          6. CANDTGT
00931              7. ENTRYP       (SEE LINE 00011)
00932              7. FINDBLK      (SEE LINE 00207)
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00933            7. CLOSCOR      (SEE LINE 00915)
00934            7. JGESJIT
00935               8. ENTRYP       (SEE LINE 00011)
00936               8. THX2XY       (SEE LINE 00228)
00937               8. ATAN2.
00938               8. EXITP        (SEE LINE 00033)
00939            7. FORMTST
00940               8. ENTRYP       (SEE LINE 00011)
00941               8. GIMME        (SEE LINE 00153)
00942               8. FINDBLK      (SEE LINE 00207)
00943               8. FINDFLT
00944                  9. ENTRYP       (SEE LINE 00011)
00945                  9. HEXDIST
00946                  9. FINDBLK      (SEE LINE 00207)
00947                  9. KOMPARE      (SEE LINE 00925)
00948                  9. GIMME        (SEE LINE 00153)
00949                  9. ADDBLOK      (SEE LINE 00359)
00950                  9. EXITP        (SEE LINE 00033)
00951               8. RELEASE      (SEE LINE 00147)
00952               8. EXITP        (SEE LINE 00033)
00953            7. GIMME        (SEE LINE 00153)
00954            7. ADDBLOK      (SEE LINE 00359)
00955            7. TGTGONE
00956               8. ENTRYP       (SEE LINE 00011)
00957               8. PTREE
00958                  9. ENTRYP       (SEE LINE 00011)
00959                  9. RELEASE      (SEE LINE 00147)
00960                  9. ISHIFT
00961                  9. EXITP        (SEE LINE 00033)
00962               8. GIMME        (SEE LINE 00153)
00963               8. EXITP        (SEE LINE 00033)
00964            7. PTREE        (SEE LINE 00957)
00965            7. RANDOM.
00966            7. RELADD
00967               8. ENTRYP       (SEE LINE 00011)
00968               8. GIMME        (SEE LINE 00153)
00969               8. PTRMRG
00970               8. EXITP        (SEE LINE 00033)
00971            7. EXITP        (SEE LINE 00033)
00972         6. ITRAP        (SEE LINE 00028)
00973         6. AVAILBL
00974            7. RELADD       (SEE LINE 00966)
00975            7. RELEASE      (SEE LINE 00147)
00976         6. SCHEDUL
00977            7. UNPACK       (SEE LINE 00189)
00978            7. RANDOM.
00979            7. RENDEVU
00980               8. UNPACK       (SEE LINE 00189)
00981               8. THX2XY       (SEE LINE 00228)
00982               8. TXY2HXL      (SEE LINE 00242)
00983            7. HEXADD       (SEE LINE 00252)
00984            7. GETHEX       (SEE LINE 00264)
00985            7. HEXDIST
00986            7. ACFRAG
00987               8. GIMME        (SEE LINE 00153)
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00988              8. UNPACK      (SEE LINE 00189)
00989              8. CRFLTML
00990                 9. CREATE
00991                   10. ENTRYP      (SEE LINE 00011)
00992                   10. GIMME       (SEE LINE 00153)
00993                   10. EXITP       (SEE LINE 00033)
00994                 9. GIMME       (SEE LINE 00153)
00995                 9. UNPACK      (SEE LINE 00189)
00996                 9. PACK        (SEE LINE 00277)
00997                 9. ADDBLOK     (SEE LINE 00359)
00998                 9. HISTORY     (SEE LINE 00330)
00999              8. ADDBLOK     (SEE LINE 00359)
01000              8. OPTPTH      (SEE LINE 00607)
01001              8. RELEASE     (SEE LINE 00147)
01002              8. PACK        (SEE LINE 00277)
01003              8. FLTGEOM
01004                 9. PACK        (SEE LINE 00277)
01005                 9. HEXCHZ      (SEE LINE 00610)
01006                 9. THH2PS      (SEE LINE 00226)
01007                 9. ATAN2.
01008              8. HEXDIST
01009              8. DELADD      (SEE LINE 00162)
01010        6. DELADD      (SEE LINE 00162)
01011        6. PLANOUT
01012           7. ENTRYP      (SEE LINE 00011)
01013           7. OUTCI.
01014           7. EXITP       (SEE LINE 00033)
01015        6. RLRAID
01016           7. ENTRYP      (SEE LINE 00011)
01017           7. RLWAVE
01018              8. ENTRYP      (SEE LINE 00011)
01019              8. RLTGTYP
01020                 9. ENTRYP      (SEE LINE 00011)
01021                 9. RELEASE     (SEE LINE 00147)
01022                 9. RLTGTAK
01023                   10. ENTRYP      (SEE LINE 00011)
01024                   10. RLFMAKT
01025                      11. ENTRYP      (SEE LINE 00011)
01026                      11. RELEASE     (SEE LINE 00147)
01027                      11. EXITP       (SEE LINE 00033)
01028                   10. RELEASE     (SEE LINE 00147)
01029                   10. EXITP       (SEE LINE 00033)
01030                 9. EXITP       (SEE LINE 00033)
01031              8. RELEASE     (SEE LINE 00147)
01032              8. EXITP       (SEE LINE 00033)
01033           7. RLCORD
01034              8. ENTRYP      (SEE LINE 00011)
01035              8. RLWBDB
01036                 9. ENTRYP      (SEE LINE 00011)
01037                 9. RELEASE     (SEE LINE 00147)
01038                 9. EXITP       (SEE LINE 00033)
01039              8. RELEASE     (SEE LINE 00147)
01040              8. EXITP       (SEE LINE 00033)
01041           7. RELEASE     (SEE LINE 00147)
01042           7. EXITP       (SEE LINE 00033)
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01043               6. EXITP        (SEE LINE 00033)
01044            5. EXITP        (SEE LINE 00033)
01045         4. PONDER
01046            5. GETPTRS      (SEE LINE 00203)
01047            5. TFLYCRC
01048               6. CRCTHNK
01049                  7. UNPACK       (SEE LINE 00189)
01050                  7. RELEASE      (SEE LINE 00147)
01051                  7. CRCKIL       (SEE LINE 00731)
01052                  7. CRCTRAK      (SEE LINE 00724)
01053                  7. CRCLOSS      (SEE LINE 00413)
01054                  7. AB2CRC
01055                     8. UNPACK       (SEE LINE 00189)
01056                     8. RELEASE      (SEE LINE 00147)
01057                     8. FINDBLK      (SEE LINE 00207)
01058                     8. GIMME        (SEE LINE 00153)
01059                     8. ADDBLOK      (SEE LINE 00359)
01060                     8. TAPES#
01061                     8. OUTCI.
01062                     8. DROPBLK      (SEE LINE 00299)
01063                  7. INT2CRC
01064                     8. UNPACK       (SEE LINE 00189)
01065                     8. FINDBLK      (SEE LINE 00207)
01066                     8. RELEASE      (SEE LINE 00147)
01067                     8. CRCKIL       (SEE LINE 00731)
01068                     8. TAPES#
01069                     8. OUTCI.
01070                     8. DETECT       (SEE LINE 00702)
01071                     8. MESBILD      (SEE LINE 00275)
01072                     8. DELADD       (SEE LINE 00162)
01073                     8. DROPBLK      (SEE LINE 00299)
01074                     8. GIMME        (SEE LINE 00153)
01075                     8. ADDBLOK      (SEE LINE 00359)
01076                  7. BTN2CRC
01077                     8. UNPACK       (SEE LINE 00189)
01078                     8. RELEASE      (SEE LINE 00147)
01079                     8. TAPES#
01080                     8. OUTCI.
01081                     8. CRCLOSS      (SEE LINE 00413)
01082                     8. CRCKIL       (SEE LINE 00731)
01083                     8. CRCTRAK      (SEE LINE 00724)
01084               6. UNSTAT       (SEE LINE 00309)
01085               6. AIRTHNK
01086                  7. HEXDIST
01087                  7. MESBILD      (SEE LINE 00275)
01088                  7. DELADD       (SEE LINE 00162)
01089                  7. TGTHEX       (SEE LINE 00220)
01090                  7. TAPES#
01091                  7. OUTCI.
01092                  7. RANDOM.
01093               6. DOGTHNK
01094                  7. MESBILD      (SEE LINE 00275)
01095                  7. DELADD       (SEE LINE 00162)
01096                  7. TAPES#
01097                  7. OUTCI.
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01098                 7. GOTOAB        (SEE LINE 00604)
01099                 7. FUELCHK       (SEE LINE 00601)
01100               6. STATPAK
01101             5. BOCTINK
01102               6. BNPONSS
01103                 7. UNPACK        (SEE LINE 00189)
01104                 7. GOTOER.
01105                 7. BNPONBB
01106                   8. FILERUP
01107                     9. RANDOM.
01108                     9. TAPE6#
01109                     9. OUTCI.
01110                     9. GIMME         (SEE LINE 00153)
01111                     9. YANK          (SEE LINE 00398)
01112                     9. STICK         (SEE LINE 00432)
01113                     9. DELADD        (SEE LINE 00162)
01114                   8. UNPACK        (SEE LINE 00189)
01115                   8. INRANGE
01116                     9. THH2PS        (SEE LINE 00226)
01117                     9. ATAN2.
01118                     9. SQRT.
01119                     9. COS.
01120                     9. TAPE6#
01121                     9. OUTCI.
01122                     9. AZILIM
01123                       10. SIN.
01124                       10. COS.
01125                       10. INSECT
01126                         11. TAN.
01127                         11. ATAN2.
01128                       10. SQRT.
01129                   8. GIMME         (SEE LINE 00153)
01130                   8. DELADD        (SEE LINE 00162)
01131                   8. SETASSN
01132                     9. UNPACK        (SEE LINE 00189)
01133                     9. PACK          (SEE LINE 00277)
01134                     9. STICK         (SEE LINE 00432)
01135                     9. PRIORTY
01136                     9. RELOCAT       (SEE LINE 00437)
01137                     9. DELADD        (SEE LINE 00162)
01138                   8. SEEKENG       (SEE LINE 00854)
01139                   8. PRIORTY
01140                   8. RELOCAT       (SEE LINE 00437)
01141                   8. STICK         (SEE LINE 00432)
01142                   8. GOTOER.
01143                   8. OLYACT        (SEE LINE 00862)
01144                   8. TAPE6#
01145                   8. OUTCI.
01146                 7. SEEKENG       (SEE LINE 00854)
01147                 7. GIMME         (SEE LINE 00153)
01148                 7. OLYACT        (SEE LINE 00862)
01149                 7. BYUPDAT
01150                   8. UNPACK        (SEE LINE 00189)
01151                   8. BNNOTRD
01152                     9. TAPE6#
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01153                    9. OUTCI.
01154                    9. RELEASE      (SEE LINE 00147)
01155                    9. OILOUT       (SEE LINE 00480)
01156                 8. BATTOUT
01157                    9. YANK         (SEE LINE 00398)
01158                    9. BNLALLE      (SEE LINE 00418)
01159                    9. UNPACK       (SEE LINE 00189)
01160                    9. CHKLAST
01161                      10. DROPPOS      (SEE LINE 00849)
01162                      10. PRIORTY
01163                      10. RELOCAT      (SEE LINE 00437)
01164                      10. DELADD       (SEE LINE 00162)
01165                    9. GIMME        (SEE LINE 00153)
01166                    9. RELEASE      (SEE LINE 00147)
01167                    9. SSLL         (SEE LINE 00868)
01168                 8. COVAPLY
01169                    9. SEEKTAC
01170                      10. DROPPOS      (SEE LINE 00849)
01171                      10. UNPACK       (SEE LINE 00189)
01172                      10. GIMME        (SEE LINE 00153)
01173                      10. PACK         (SEE LINE 00277)
01174                      10. RELEASE      (SEE LINE 00147)
01175                      10. SSLL         (SEE LINE 00868)
01176                      10. DELADD       (SEE LINE 00162)
01177                      10. ALLOBAT      (SEE LINE 00874)
01178                      10. YANK         (SEE LINE 00398)
01179                      10. READOIL      (SEE LINE 00429)
01180                    9. GIMME        (SEE LINE 00153)
01181                    9. DLYACT       (SEE LINE 00862)
01182                    9. RELEASE      (SEE LINE 00147)
01183                 8. GIMME        (SEE LINE 00153)
01184                 8. PACK         (SEE LINE 00277)
01185                 8. SSLL         (SEE LINE 00868)
01186                 8. DECRALD
01187                    9. MESBILD      (SEE LINE 00275)
01188                    9. DELADD       (SEE LINE 00162)
01189                    9. TAPE6#
01190                    9. OUTCI.
01191                 8. SEEKTAC      (SEE LINE 01169)
01192                 8. DLYACT       (SEE LINE 00862)
01193                 8. RELEASE      (SEE LINE 00147)
01194           6. BNPONEP
01195              7. GOTDER.
01196              7. SKSBTRK
01197                 8. UNPACK       (SEE LINE 00189)
01198                 8. SEEKP
01199              7. DROPPOS      (SEE LINE 00849)
01200              7. BNLALLE      (SEE LINE 00418)
01201              7. UNPACK       (SEE LINE 00189)
01202              7. CHKLAST      (SEE LINE 01160)
01203              7. SEEKTAC      (SEE LINE 01169)
01204              7. GIMME        (SEE LINE 00153)
01205              7. PACK         (SEE LINE 00277)
01206              7. DLYACT       (SEE LINE 00862)
01207              7. SEEKENG      (SEE LINE 00854)
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01208          7. MESBILD      (SEE LINE 00275)
01209          7. DELADD       (SEE LINE 00162)
01210          7. YANK         (SEE LINE 00398)
01211          7. STICK        (SEE LINE 00432)
01212          7. READIL       (SEE LINE 00429)
01213        6. BNCMOPR
01214          7. GOTOER.
01215          7. ACCEPT
01216            8. UNPACK       (SEE LINE 00189)
01217            8. SEEKP
01218            8. GIMME        (SEE LINE 00153)
01219            8. STOP.
01220            8. STICK        (SEE LINE 00432)
01221            8. DETECT       (SEE LINE 00702)
01222            8. DELADD       (SEE LINE 00162)
01223            8. PACK         (SEE LINE 00277)
01224            8. TAPES#
01225            8. OUTCI.
01226            8. BYALCOV
01227              9. UNPACK       (SEE LINE 00189)
01228              9. PACK         (SEE LINE 00277)
01229              9. GIMME        (SEE LINE 00153)
01230              9. SSLL         (SEE LINE 00868)
01231              9. CANCALD      (SEE LINE 00424)
01232              9. SEEKTFU      (SEE LINE 00443)
01233              9. RELEASE      (SEE LINE 00147)
01234              9. PATDEC
01235                10. CANCALD     (SEE LINE 00424)
01236                10. SEEKTFU     (SEE LINE 00443)
01237              9. BATTCOV
01238                10. TRKCHEK     (SEE LINE 00444)
01239                10. ALLOFU      (SEE LINE 00462)
01240                10. ALLOPAT     (SEE LINE 00468)
01241              9. DLYACT       (SEE LINE 00862)
01242              9. TAPE6#
01243              9. OUTCI.
01244            8. RELEASE      (SEE LINE 00147)
01245            8. BYMEDUP
01246              9. SEEKP
01247              9. UNPACK       (SEE LINE 00189)
01248              9. DELADD       (SEE LINE 00162)
01249              9. RELOCAT      (SEE LINE 00437)
01250              9. BATTCOV      (SEE LINE 01237)
01251              9. MESBILD      (SEE LINE 00275)
01252              9. RELEASE      (SEE LINE 00147)
01253            8. OUTA         (SEE LINE 00403)
01254          7. MESBILD      (SEE LINE 00275)
01255          7. DELADD       (SEE LINE 00162)
01256          7. SEEKP
01257          7. DROPPOS      (SEE LINE 00849)
01258          7. OILOUT       (SEE LINE 00480)
01259        6. BNPONFA
01260          7. SEEKP
01261          7. TAPES#
01262          7. OUTCI.
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01263                7. BNRECOV
01264                   8. UNPACK        (SEE LINE 00189)
01265                   8. WITHDRAW
01266                      9. UNPACK        (SEE LINE 00189)
01267                      9. GIMME         (SEE LINE 00153)
01268                      9. PACK          (SEE LINE 00277)
01269                      9. SSLL          (SEE LINE 00868)
01270                      9. DECRALO       (SEE LINE 01186)
01271                      9. SEEKENG       (SEE LINE 00854)
01272                      9. OLYACT        (SEE LINE 00862)
01273                      9. RELEASE       (SEE LINE 00147)
01274                   8. PACK          (SEE LINE 00277)
01275             6. BNPONFD
01276                7. SEEKP
01277                7. TAPES#
01278                7. OUTCI.
01279                7. RELEASE      (SEE LINE 00147)
01280                7. YANK         (SEE LINE 00398)
01281                7. DROPPOS      (SEE LINE 00849)
01282                7. DILOUT       (SEE LINE 00480)
01283                7. MESBILD      (SEE LINE 00275)
01284                7. DELADD       (SEE LINE 00162)
01285             6. RELEASE     (SEE LINE 00147)
01286             6. SDIGEST
01287                7. UNPACK       (SEE LINE 00189)
01288                7. GIMME        (SEE LINE 00153)
01289                7. PACK         (SEE LINE 00277)
01290                7. TAPES#
01291                7. OUTCI.
01292                7. RANDOM.
01293                7. BNNWTRK
01294                   8. CHKCOV
01295                      9. UNPACK        (SEE LINE 00189)
01296                      9. INRANGE       (SEE LINE 01115)
01297                      9. GIMME         (SEE LINE 00153)
01298                      9. TAPE6#
01299                      9. OUTCI.
01300                      9. OUTA          (SEE LINE 00403)
01301                      9. DELADD        (SEE LINE 00162)
01302                   8. BNLALLE       (SEE LINE 00418)
01303                   8. SETASSN       (SEE LINE 01131)
01304                   8. SEEKTAC       (SEE LINE 01169)
01305                   8. GIMME         (SEE LINE 00153)
01306                   8. OLYACT        (SEE LINE 00862)
01307                7. BYNWTRK
01308                   8. MESBILD       (SEE LINE 00275)
01309                   8. DELADD        (SEE LINE 00162)
01310                   8. BNLALLE       (SEE LINE 00418)
01311                   8. INRANGE       (SEE LINE 01115)
01312                   8. PREPAFU
01313                      9. UNPACK        (SEE LINE 00189)
01314                      9. PACK          (SEE LINE 00277)
01315                      9. AUTOPRI
01316                      9. STICK         (SEE LINE 00432)
01317                      9. RELOCAT       (SEE LINE 00437)
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01318                 9. DELADO       (SEE LINE 00162)
01319              8. BATTCOV      (SEE LINE 01237)
01320              8. GIMME        (SEE LINE 00153)
01321              8. DLYACT       (SEE LINE 00862)
01322              8. STICK        (SEE LINE 00432)
01323              8. RELOCAT      (SEE LINE 00437)
01324           7. YANK         (SEE LINE 00398)
01325           7. RELEASE      (SEE LINE 00147)
01326           7. TOADIL       (SEE LINE 00454)
01327           7. STICK        (SEE LINE 00432)
01328           7. BNCONTC
01329              8. CHKCOV       (SEE LINE 01294)
01330              8. DROPPOS      (SEE LINE 00849)
01331              8. AVLALLE      (SEE LINE 00419)
01332              8. SETASSN      (SEE LINE 01131)
01333              8. SEEKTAC      (SEE LINE 01169)
01334              8. GIMME        (SEE LINE 00153)
01335              8. DLYACT       (SEE LINE 00862)
01336              8. CHKLAST      (SEE LINE 01150)
01337              8. BNCONHO
01338                 9. TAPE6#
01339                 9. OUTCI.
01340                 9. GIMME        (SEE LINE 00153)
01341                 9. MESBILD      (SEE LINE 00275)
01342                 9. PRIORTY
01343                 9. PACK         (SEE LINE 00277)
01344                 9. DELADO       (SEE LINE 00162)
01345                 9. YANK         (SEE LINE 00398)
01346                 9. STICK        (SEE LINE 00432)
01347                 9. RELEASE      (SEE LINE 00147)
01348                 9. DROPPOS      (SEE LINE 00849)
01349                 9. SEEKTAC      (SEE LINE 01169)
01350                 9. DLYACT       (SEE LINE 00862)
01351              8. AVRECOV      (SEE LINE 01263)
01352              8. TAPES#
01353              8. OUTCI.
01354              8. YANK         (SEE LINE 00398)
01355              8. STICK        (SEE LINE 00432)
01356              8. TOADIL       (SEE LINE 00454)
01357              8. DILOUT       (SEE LINE 00480)
01358           7. BYCONTC
01359              8. MESBILD      (SEE LINE 00275)
01360              8. DELADO       (SEE LINE 00162)
01361              8. INRANGE      (SEE LINE 01115)
01362              8. BATCEAS      (SEE LINE 00423)
01363              8. AVLALLE      (SEE LINE 00418)
01364              8. PREPAFU      (SEE LINE 01312)
01365              8. BATTCOV      (SEE LINE 01237)
01366              8. GIMME        (SEE LINE 00153)
01367              8. DLYACT       (SEE LINE 00862)
01368              8. BYCONHO
01369                 9. TAPE6#
01370                 9. OUTCI.
01371                 9. DELADO       (SEE LINE 00162)
01372                 9. AUTOPRI
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01373                       9. STICK        (SEE LINE 00432)
01374                       9. RELOCAT      (SEE LINE 00437)
01375                       9. BATTCOV      (SEE LINE 01237)
01376                       9. GIMME        (SEE LINE 00153)
01377                       9. OLYACT       (SEE LINE 00862)
01378                    8. UNPACK       (SEE LINE 00189)
01379                    8. BYALCOV      (SEE LINE 01226)
01380                    8. STICK        (SEE LINE 00432)
01381                    8. RELOCAT      (SEE LINE 00437)
01382                    8. YANK         (SEE LINE 00398)
01383                    8. TOADILI      (SEE LINE 00454)
01384                 7. OLYACT       (SEE LINE 00862)
01385                 7. BNCONLS
01386                    8. DROPPOS      (SEE LINE 00849)
01387                    8. DILOUT       (SEE LINE 00480)
01388                    8. MESBILD      (SEE LINE 00275)
01389                    8. DELADD       (SEE LINE 00162)
01390                 7. BYCONLS
01391                    8. BATCEAS      (SEE LINE 00423)
01392                    8. BNLALLE      (SEE LINE 00418)
01393                    8. MESBILD      (SEE LINE 00275)
01394                    8. DELADD       (SEE LINE 00162)
01395                    8. DILOUT       (SEE LINE 00480)
01396                 7. BNLALLE      (SEE LINE 00418)
01397                 7. DELADD       (SEE LINE 00162)
01398              6. BNPONDA
01399                 7. YANK         (SEE LINE 00398)
01400                 7. UNPACK       (SEE LINE 00189)
01401                 7. GOTOER.
01402                 7. SETASSN      (SEE LINE 01131)
01403                 7. SEEKTAC      (SEE LINE 01169)
01404                 7. CHKCOV       (SEE LINE 01294)
01405                 7. BNLALLE      (SEE LINE 00418)
01406                 7. GIMME        (SEE LINE 00153)
01407                 7. OLYACT       (SEE LINE 00862)
01408                 7. BNCONTC      (SEE LINE 01328)
01409                 7. SEEKENG      (SEE LINE 00854)
01410                 7. RELEASE      (SEE LINE 00147)
01411              6. TAPES#
01412              6. OUTCI.
01413              6. DROPPOS      (SEE LINE 00849)
01414              6. BNLALLE      (SEE LINE 00418)
01415              6. MESBILD      (SEE LINE 00275)
01416              6. DELADD       (SEE LINE 00162)
01417              6. DILOUT       (SEE LINE 00480)
01418              6. BNPONBD
01419                 7. TAPES#
01420                 7. OUTCI.
01421                 7. BNNOTRO      (SEE LINE 01151)
01422                 7. BATTOUT      (SEE LINE 01156)
01423                 7. COVAPLY      (SEE LINE 01168)
01424                 7. RELEASE      (SEE LINE 00147)
01425              6. SAMATON
01426                 7. UNPACK       (SEE LINE 00189)
01427                 7. AUTOPRI
```

```
01428                  7. RELOCAT     (SEE LINE 00437)
01429                  7. RELEASE     (SEE LINE 00147)
01430                  7. DILOJT      (SEE LINE 00480)
01431                  7. TOADIL      (SEE LINE 00454)
01432                  7. DELADD      (SEE LINE 00162)
01433                  7. TAPES#
01434                  7. OUTCI.
01435              6. ALLOBAT     (SEE LINE 00874)
01436          5. BTRYTNK
01437              6. BYCMOPR
01438                  7. ACCEPT      (SEE LINE 01215)
01439                  7. SEEKP
01440                  7. TAPES#
01441                  7. OUTCI.
01442                  7. BATCEAS     (SEE LINE 00423)
01443                  7. DILOJT      (SEE LINE 00480)
01444                  7. BYALCOV     (SEE LINE 01226)
01445                  7. BYHEDUP     (SEE LINE 01245)
01446                  7. RELEASE     (SEE LINE 00147)
01447              6. SDIGEST     (SEE LINE 01286)
01448              6. SEEKP
01449              6. BYPONTM
01450                  7. GIMME       (SEE LINE 00153)
01451                  7. UNPACK      (SEE LINE 00189)
01452                  7. PACK        (SEE LINE 00277)
01453                  7. TAPES#
01454                  7. OUTCI.
01455                  7. BYCONTC     (SEE LINE 01358)
01456                  7. TRYSHOT     (SEE LINE 00547)
01457                  7. DELADD      (SEE LINE 00162)
01458                  7. RELEASE     (SEE LINE 00147)
01459              6. BYPONER
01460                  7. UNPACK      (SEE LINE 00189)
01461                  7. CANCALO     (SEE LINE 00424)
01462                  7. SEEKTFU     (SEE LINE 00443)
01463                  7. BATTCOV     (SEE LINE 01237)
01464                  7. DILOJT      (SEE LINE 00480)
01465                  7. PACK        (SEE LINE 00277)
01466                  7. DELADD      (SEE LINE 00162)
01467                  7. PTPONER
01468                      8. UNPACK      (SEE LINE 00189)
01469                      8. PACK        (SEE LINE 00277)
01470                      8. CANCALO     (SEE LINE 00424)
01471                      8. SEEKTFU     (SEE LINE 00443)
01472                      8. DILOJT      (SEE LINE 00480)
01473                      8. DELADD      (SEE LINE 00162)
01474                  7. MESBILD     (SEE LINE 00275)
01475                  7. RELEASE     (SEE LINE 00147)
01476              6. TAPE6#
01477              6. OUTCI.
01478              6. YANK        (SEE LINE 00398)
01479              6. BATCEAS     (SEE LINE 00423)
01480              6. BNLALLE     (SEE LINE 00418)
01481              6. MESBILD     (SEE LINE 00275)
01482              6. DELADD      (SEE LINE 00162)
```

```
01483              6. BYPONFO
01484                 7. SEEKP
01485                 7. YANK          (SEE LINE 00398)
01486                 7. RELEASE       (SEE LINE 00147)
01487                 7. BATCEAS       (SEE LINE 00423)
01488                 7. DILOJT        (SEE LINE 00480)
01489                 7. BYENDPS       (SEE LINE 00395)
01490                 7. MESBILD       (SEE LINE 00275)
01491                 7. DELADD        (SEE LINE 00162)
01492              6. SAMATON       (SEE LINE 01425)
01493              6. BYPONRL
01494                 7. UNPACK        (SEE LINE 00189)
01495                 7. GOTOER.
01496                 7. FILERUP       (SEE LINE 01106)
01497                 7. INRANGE       (SEE LINE 01115)
01498                 7. PREPAFU       (SEE LINE 01312)
01499                 7. MESBILD       (SEE LINE 00275)
01500                 7. DELADD        (SEE LINE 00162)
01501                 7. SEEKTFU       (SEE LINE 00443)
01502                 7. TAPES#
01503                 7. OUTCI.
01504              6. BYPONRS
01505                 7. UNPACK        (SEE LINE 00189)
01506                 7. RELOAD
01507                    8. GIMME         (SEE LINE 00153)
01508                    8. GOTOER.
01509                    8. DELADD        (SEE LINE 00162)
01510                    8. RESUPLY
01511                       9. GIMME         (SEE LINE 00153)
01512                       9. DELADD        (SEE LINE 00162)
01513                 7. TAPES#
01514                 7. OUTCI.
01515                 7. RELEASE       (SEE LINE 00147)
01516        4. TOWER
01517           5. GETPTRS       (SEE LINE 00203)
01518           5. TAPE6#
01519           5. OUTCI.
01520           5. UNPACK        (SEE LINE 00189)
01521           5. UOLLOAD       (SEE LINE 00596)
01522           5. INITACQ
01523              6. ENTRYP        (SEE LINE 00011)
01524              6. GIMME         (SEE LINE 00153)
01525              6. ADDBLOK       (SEE LINE 00359)
01526              6. ALOG.
01527              6. MESAGE        (SEE LINE 00012)
01528              6. RITEI         (SEE LINE 00015)
01529              6. XTOI.
01530              6. NOWUCIT       (SEE LINE 00350)
01531              6. EXITP         (SEE LINE 00033)
01532           5. DELADD        (SEE LINE 00162)
01533           5. PACK          (SEE LINE 00277)
01534           5. FINDBLK       (SEE LINE 00207)
01535           5. REDEBRF
01536              6. UNPACK        (SEE LINE 00189)
01537              6. FINDBLK       (SEE LINE 00207)
```

```
01538              6. WIPEOUT
01539              6. GIMME         (SEE LINE 00153)
01540              6. ADDBLOK       (SEE LINE 00359)
01541              6. PELADD        (SEE LINE 00966)
01542              6. DESTROY       (SEE LINE 00343)
01543           5. GIMME         (SEE LINE 00153)
01544           5. GOGETEM
01545              6. UNPACK        (SEE LINE 00189)
01546              6. FINDBLK       (SEE LINE 00207)
01547              6. CRFLTML       (SEE LINE 00989)
01548              6. TAPE6#
01549              6. OUTCI.
01550              6. GIMME         (SEE LINE 00153)
01551              6. ADDBLOK       (SEE LINE 00359)
01552              6. PTRAND
01553                 7. UNPACK        (SEE LINE 00189)
01554                 7. RANDOM.
01555                 7. HEXADD        (SEE LINE 00252)
01556                 7. HEXMULT       (SEE LINE 00353)
01557                 7. GETHEX        (SEE LINE 00264)
01558              6. PACK          (SEE LINE 00277)
01559              6. FLTGEOM       (SEE LINE 01003)
01560              6. UOLLOAD       (SEE LINE 00596)
01561              6. INITACQ       (SEE LINE 01522)
01562              6. DELADD        (SEE LINE 00162)
01563              6. MESBILD       (SEE LINE 00275)
01564           5. MESBILD       (SEE LINE 00275)
01565           5. DESTROY       (SEE LINE 00343)
01566        4. UMPIRE
01567           5. UNPACK        (SEE LINE 00189)
01568           5. THH2PS        (SEE LINE 00226)
01569           5. SQRT.
01570           5. XTOI.
01571           5. HISTORY       (SEE LINE 00330)
01572           5. RANDOM.
01573           5. TAPE6#
01574           5. OUTCI.
01575           5. GIMME         (SEE LINE 00153)
01576           5. PACK          (SEE LINE 00277)
01577           5. DELADD        (SEE LINE 00162)
01578           5. DESTROY       (SEE LINE 00343)
01579           5. RELEASE       (SEE LINE 00147)
01580           5. NUKBLND       (SEE LINE 00509)
01581        4. TAPE6#
01582        4. OUTCI.
01583        4. OUTCR.
01584        4. EXITP         (SEE LINE 00033)
01585     3. SNAP          (SEE LINE 00168)
01586     3. UNSNAP        (SEE LINE 00196)
01587     3. RELEASE       (SEE LINE 00147)
01588     3. SECOND
01589     3. HLTPNT
01590        4. ENTRYP        (SEE LINE 00011)
01591        4. SECOND
01592        4. HALT          (SEE LINE 00009)
```

```
01593                 4. EXITP          (SEE LINE 00033)
01594              3. EXITP          (SEF LINE 00033)
01595          2. EXITP          (SEE LINE 00033)
01596          2. END.
```

3. Post Processor

LIST OF SUBROUTINES - RECORD

1. EOF
2. INDEX
3. MESAGE
4. PAGE
5. RECORD
6. RITEI
7. RITER
8. TABOUT

LIST OF FORTRAN LIBRARY ROUTINES - RECORD

1. INPCI.
2. INPFI.
3. OUTCI.
4. OUTCR.
5. QINTRY.
6. STOP.
7. TAPE6#

SUBROUTINE REFERENCE LIST - RECORD

1. EOF		CALLED BY: RECORD
2. INDEX	CALLS: TAPE6# OUTCI.	CALLED BY: RECORD
3. MESAGE	CALLS: TAPE6# OUTCI.	CALLED BY: TABOUT RECORD
4. PAGE	CALLS: TAPE6# OUTCI.	CALLED BY: TABOUT RECORD
5. RECORD	CALLS: QINTRY. INPCI. INPFI. PAGE OUTCI. EOF INDEX MESAGE RITEI RITER TABOUT STOP.	
6. RITEI	CALLS: TAPE6# OUTCI.	CALLED BY: RECORD
7. RITER	CALLS: TAPE6# OUTCI.	CALLED BY: RECORD
8. TABOUT	CALLS: PAGE MESAGE TAPE6# OUTCI. OUTCR.	CALLED BY: RECORD

FORTRAN LIBRARY REFERENCE LIST - RECORD

1. INPCI.	CALLED BY: RECORD
2. INPFI.	CALLED BY: RECORD
3. OUTCI.	CALLED BY: TABOUT, RITER, RITEI, PAGE, MESAGE, INDEX, RECORD
4. OUTCR.	CALLED BY: TABOUT
5. QINTRY.	CALLED BY: RECORD
6. STOP.	CALLED BY: RECORD
7. TAPE6*	CALLED BY: TABOUT, RITER, RITEI, PAGE, MESAGE, INDEX

RECORD SUBROUTINE CALLING HIERARCHY -

```
00001      1. RECORD
00002         2. QINTRY.
00003         2. INPCI.
00004         2. INPFI.
00005         2. PAGE
00006            3. TAPE6#
00007            3. OUTCI.
00008         2. OUTCI.
00009         2. EOF
00010         2. INDEX
00011            3. TAPE5#
00012            3. OUTCI.
00013         2. MESAGE
00014            3. TAPE6#
00015            3. OUTCI.
00016         2. RITEI
00017            3. TAPE5#
00018            3. OUTCI.
00019         2. RITER
00020            3. TAPE6#
00021            3. OUTCI.
00022         2. TABOUT
00023            3. PAGE          (SEE LINE 00005)
00024            3. MESAGE        (SEE LINE 00013)
00025            3. TAPE6#
00026            3. OUTCI.
00027            3. OUTCR.
00028         2. STOP.
```

APPENDIX I

MADEM DEBUG ROUTINES

This appendix contains an alphabetical list and description of the debug routines available in MADEM. Following this list is a more detailed description of how to implement certain of these capabilities.

ADUMP - Dumps to the printer any array in octal.

Parameters:

- IARRAY - array to be dumped
- ISTART - offset of first word to be dumped
- LENGTH - number of words to be dumped
- INAME - hollerith name of the array

ANALYZE - A separate program that analyzes a binary file and gives the following information:

- Cross reference of all routine calls
- Complete calling hierarchy

BLOCK DATA ROUTINES - 41 routines, each representing a data block, that can be manipulated to creat data structure display routines. Each block routine is capable of printing data blocks or a list of data blocks, and of calling other block routines to print subordinate lists.

Parameters:

- POINTER - pointer to first data block
- LEVEL - number of hierarchical types of blocks to print in the data structure
- MAXBLKS - number of blocks in the main list to be printed.

CLIST (and CLIST2) - Common block dump routine. Prints key common pointer values.

DBGREAD - Debug parameter read routine. Reads all input parameters used for debug purposes. These parameters are interpreted and the necessary flags are set to activate these parameters. Invalid parameters are ignored.

DISPLAT - Display DATFILE data structure. Uses 13 of the block data routines. Activated by a debug parameter.

ENTRYP - Entry debug routine. Called at the beginning of most MADEM subroutines. Keeps track of the calling hierarchy in the pushdown stack and of the last 50 routines called in the circular list. Counts the number of times each routine calls ENTRYD and, along with EXITP, times the exectuion of these routines. Optionally, ENTRYP can call debug routines ITRAP and ICHEC. Also, can optionally print specified routine trace messages. These options are set through debug parameters.

Parameter:

SEGNUM - segment number of calling routine

ENTSTAT - Prints vector of routine entry counts, execution times, trace message flags, and debug call flags.

EXITP - Same as ENTRYP, but called at the end of a routine rather than at the beginning.

Parameter:

SEGNUM - segment number of calling routine

HALT - Used whenever the simulation is to be stopped. Performs the following functions, mostly through subroutine calls:

- creates hold files for restarts
- prints name of calling subroutine
- prints reason for termination.
- prints pushdown stack
- prints names of last 50 routines called
- calls ENTSTAT (see ENTSTAT)

- calls CLIST (see CLIST)
- optionally (controlled by debug parameter) prints ISPACE.
- Stops the simulation.

Parameters:

SEGNUM - segment number of calling routine

MSGHALT - forty character message

ICHECK - Checks specified locations in ISPACE, and prints a message when the value of that location changes. The message indicates the old value, the new value, and the last non-debug routine called. The ISPACE locations are selected through debug parameters read by DBGREAD. DEBUG must be set to "ON" for ICHECK to be called from any given routine (see DBGREAD).

Parameter:

SEGNUM - segment number of calling routine

ICOMP - A separate program that compares two sets of hold files and indicates when there are differences in the ISPACES. Used when midasizing, to insure the midasized version runs the same as the unmidasized version.

Parameters:

ISTART - first word of ISPACE to be compared

IMAX - last word of ISPACE to be compared

MAXDIFF - maximum number of mismatches before stopping

IEXTRA - maximum number of extra words printed if one ISPACE is larger than the other.

HSIZE1 - number of ISPACE words in each hold file for second ISPACE.

ISDUMP - Dumps to printer selected portions or all of the ISPACE array. Will always print at least the first ten words.

Parameters:

ISTART - first word to be dumped

LENGTH - number of words to be dumped

ITRAP - Checks ISPACE of zero and ISPACE locations one through eight for proper values. ISPACE of zero should always be equal to 99999999.0, and other eight locations should always be zero. If any of these locations have improper values, then HALT is called to stop the simulation and print debug information. DEBUG must be set to "ON" for ITRAP to be called from ENTRYP and EXITP (see DBGRAD).

Parameter:

SEGNUM - segment number of calling routine, or of routine that called ENTRYP/EXIT.

LOCATE - A batch text search program that can be used as a MIDAS cross reference program.

NIPULSTOR - A post run debugging facility that can:

1. Print selected areas of ISPACE.
2. Dump the C2 data structures.
3. Dump the EVENT tree.
4. Dump structures of a given unit.
5. Call CLIST.

See the detailed description at the end of this appendix.

RECCON - Activated only by RECOUR in the event of abnormal job termination and subsequent recovery. Calls HALT to print debug inforamtion and stop the simulation.

RECER - Prints current calling hierarchy (pushdown stack) and the names of the last 50 subroutines called (circular list).

RECOUR - Allows the MADEM program to regain control of execution at the time that abnormal job termination would otherwise occur. RECOUR calls RECCON in the event of catastrophic failure. RECOUR is automatically initialized at the beginning of the MADEM Program. RECOUR may be turned off by using debug parameter "RECOUR=OFF."

Parameters:

NAME - name of the routine to be executed if flagged conditions occur (RECCON)

FLAGS - octal value of error conditions that trip RECOUR (Ø77)

CHECKSUM - No checksum desired (Ø)

ROUTER - Same as RECER, but with SEGNUM as a parameter, so the calling routine name can be printed.

MADEM DEBUG PARAMETERS

The INPUT file to MADEM holds various parameters that affect only the particular volume that is being run. The first input card holds seven numbers described under MADEM Operations. This card is mandatory. Debug parameters follow this first card, and are entirely optional. There are a variety of debug options which may be turned on or off by using debug parameters. These options and their corresponding parameters are listed below. Parameters, except where noted otherwise, must begin in column one. All parameters are actually ten characters long, with either leading or trailing blanks implied.

The debug options:

1. Debug Status

For each routine that calls ENTRYP and EXITP, the debug status is set to either "ON" or "OFF". When debug is "ON" for a routine, then ENTRYP and EXITP have the addition of calling ITRAP and ICHECK when processing

that routine. This slows down execution considerably when many routines are "ON," but is a valuable debug tool.

DEFAULT: Debug is "OFF" for all routines.

PARAMETERS:

"DEBUG=ONb̸b̸" - turns delay to "ON" for all routines

"DXXXXXXXb̸b̸ - where XXXXXXX is a routine name. Changes the debug status of that routine only. If it was "ON," it is set to "OFF," and vice-versa. By using "DEBUG-ONb̸b̸" followed by a few occurrences of this parameter, all routines but a few can be set to "ON." Likewise, by only using this parameter, only a few routines can be set to "ON."

2. Trace Status

The same as debug status, except that what is being turned "ON" and "OFF" is the printing of subroutine call trace messages.

DEFAULT: Trace is "OFF" for all routines.

PARAMETERS:

"TRACEONb̸b̸" - turns on trace messages for all routines.

"TXXXXXXXb̸b̸ - same as "DXXXXXXXb̸b̸" but for the trace status.

Never use "TRACE=ON" by itself. The resulting output will be thousands of pages of trace messages.

3. Recovery Status

Controls the initilizing of system recover routine RECOUR. When recover is "ON," then RECOUR will be initiated upon abnormal termination. When Recover is "OFF," no calls will be made to RECOURI.

DEFAULT: Recover is set to "ON"

PARAMETER:

"RECOUR=OFF" - turns off recovery routine.

4. Icheck Status

Controls ISPACE locations checked by debug routine ICHECK. To have ISPACE locations checked, the word "CHECK" must start in column 1, followed on the same card by up to seven decimal ISPACE pointer right justified ending in columsn 1Øx, where x = 2 thru 8. All check cards together may not have more than ten ISPACE locations.

DEFAULT: no ISPACE locations are checked.

5. Release Status

The allocation of blocks in ISPACE is controlled by two routines: GIMME and RELEASE. Release un-allocates previously used storage for future use. Sometimes it is advantageous to turn off release so that all new blocks will be allocated at the end of "used" ISPACE (free space). This is done by turning the release status off. It also must be indicated after which event within the volume that release is turned off. To turn release off, put "RELEASEbbb" beginning in column one, followed on the same card by a decimal number ending in column 2Ø. This number is the event after which release is turned off.

DEFAULT: Release is never turned off.

6. Stop Status (Pre-processor only)

The Stop Status controls how far the preprocessor runs before stopping. There is no restart capability for the preprocessor; the early stops are for debugging purposes only.

DEFAULT: Pre-processor runs to normal completion.

PARAMETERS:

"STOP=ODATb" - stops after reading DATFILE.

"STOP=UOILb" - stops after reading UOIL.

"STOP=DEL" - stops after planning first event.

7. Datfile Display (Pre-processor only)

To get DISPDAT to print the DATFILE data structure, use parameter "DATFLE=ONb".

DEFAULT: Datfile is not displayed
PARAMETER:
"DATFLE=ONȸ"

8. Ispace Dump
DEFAULT: only first ten words of ISPACE are dumped
PARAMETER:
"DUMP=ONȸȸȸ" - all of ISPACE dumped.

NIPULAT8TOR

NIPUL8TOR is a fortran program that was written to use as a debugging tool for MADEM. NIPUL8TOR can dump selected areas of ISPACE, selected data structures, or MADEM's common blocks.

At the end of each MADEM run (or volume of a run), MADEM saves ISPACE and all other common blocks in a series of files. NIPUL8TOR gets ISPACE and the common blcoks from this series of files. To maintain compatibility, NIPUL8TOR uses MADEM's fetch routine to retrieve the data from these files. NIPUL8TOR also uses MADEM's CLIST subroutine, as well as the subroutines that CLIST calls.

USING NIPUL8TOR

To use NIPUL8TOR, you need:

1) The binary file "NIPUL8TOR"
2) The series of MADEM files that holds ISPACE and the common blocks
3) The correct set of NIPUL8TOR directives that tell NIPUL8TOR exactly which dumps you want.

The sample JCL deck on the next page shows the input that will give you an end of Volume 3 dump that exercises all the NIPUL8TOR options. The first four attach commands access the MADEM files that were dumped by a volume 3 run. The NIPUL8TOR directives (commands) and directive parameters are also shown.

```
WBDMBSM,ST176,T200,I0177,P60,EC400.      MADEM NIPUL8TOR RUN
ACCOUNT BSMBUM, WDNA14V6-SGC,BDM,703-821-4223.    B MACALLER
COMMENT.
COMMENT.  ***************************************
COMMENT.  * VOLUME 1, RUN TYPE AAA              *
COMMENT.  ***************************************
ATTACH,TAPE15,PLAN1AAA,ID=WDNA14V6.
ATTACH,TAPE16,PLAN2AAA,ID=WDNA14V6.
ATTACH,LGO,NIPUL8TOR,ID=WDNA14V6.
LDSET,PRESET=ZERO.
LOAD,LGO.
EXECUTE,,PL=50000.
AUDIT,ID=WDNA14V6.
EXIT.
AUDIT,ID=WDA14V6.
&         EOR
1                           DUMP SELECTED AREA OF ISPACE
1000,2000
2                           DUMP AROUND A WORD OF ISAPCE
1500,500
3                           DUMP A C2 STRUCTURE
PTR=002196
3                           DUMP THE BLUE C2 TREE
BLUE
3                           DUMP THE RED C2 TREE
RED
4                           DUMP LEFTIST TREE AND EVENT NODE INFO
PTR=012345
4                           DUMP THE DEL AND EVENT INFO
DEL
6                           DUMP STRUCTURES OF A GIVEN UNIT
14225
7                           DUMP COMMON BLOCKS
7
#          EOI
```

DIRECTIVES FOR NIPUL8TOR

Directives, submitted through an input deck, tell NIPUL8TOR exactly what to dump. Depending on the directive, there may be zero, one, or two parameters on the input card following the directive. The directive appears alone on a card. The directive is a digit (1-7), and directive parameters are either decimal integers or commands, as indicated below. There is no limit to the number of directives used in the SIPUL8TOR run, or to the number of repetitions of any one directive. The directives are not order dependent.

DIRECTIVE 1: Dump a selected area of ISPACE. This directive will dump a chunk of ISPACE, as defined by the two parameters.

PARAMETERS

1) First word of ISPACE to be dumped.
2) Last word of ISPACE to be dumped.

Obviously, the first PARM must be less than or equal to the second PARM.

DIRECTIVE 2: Dump around a word of ISAPCE. This directive will also dump a chunk of ISPACE as defined by the two parameters, but the PARMS have different meanings.

PARAMETERS

1) Middle word of ISPACE area to be dumped.
2) Number of words on either side of the middle word, to be dumped.

DIRECTIVE 3: Dump the C2 structure CTREED. This directive will display a C2 tree as defined by the parameter. It may be used to dump the red or blue C2 trees, or any subset of a C2 tree. For each unit in the C2 tree, the SB, SDB, C2, and unit status board blocks will be displayed.

PARAMETERS

3 options that define the C2 tree:

1) RED - dumps the red C2 tree
2) BLUE - dumps the blue C2 tree
3) PTR=IIIIII, where IIIIII = pointer to buffer at top of C2 tree. (IIIIII is a right justified 6 digit integer).

To dump a subset of a tree, use PTR=XXXXXX, where XXXXXX = PTRC2 + 1, where PTRC2 points to unit above the top unit in the subset. (i.e, PJRCZ + 1 simulates the buffer).

DIRECTIVE 4: Dump leftist tree and event node info. This directive will dump the leftist tree and corresponding event blocks.

PARAMETERS

One PARM, defines leftist tree.

2 options:

1) DEL - dumps discrete event list
2) PTR = IIIIII, where IIIIII is a right justified 6 digit integer that points to the top node in the tree.

DIRECTIVE 5: Not used. Future plans call for a hex structure dump.

DIRECTIVE 6: Dump structures of a given unit. This directive can be used to dump the blocks of a given unit, where the unit is displayed as in the C2 dump.

PARAMETER

Decimal integer pointer to the C2 unit to be dumped.

DIRECTIVE 7: Dump the common blocks. This directive will display most of MADEM's common blocks.

No PARAMETERS, do not use a second card.

APPENDIX J

MADEM DATA STRUCTURE CROSS REFERENCE

	MADEM	ABQUEUE	ABSEF	ABVSCOR	AB2CRC	ACCEPT	ACFRAG	ADASASS	ADDBLOK	AIRTHNK	ALLOBAT	ALLOFU	ALLOPAT	AMMOCHK	ASSIGN	ATKASES	ATTACK	AUTOPRI	AVAILBL	AZIIM	BADMOVE	BATCEAS	BATTCOV	BATTOUT
CHOLD																								
TYPES																								
TRACK	●																							
THRPLN	●																							
STATBD	●			●															●					
SPSTAT	●																							
SPACE	●																							
SEMINFO	●	●		●			●	●	●										●					
SAMPTRS																								
SAMPK	●																							
SAMPH	●																							
PATH																								
MXMIS																								
MODVAR	●						●																	
MASK	●								●															
LIMITS	●																							
JJOPT	●																							
IODEV	●																							
INITPTR	●			●																				
HALT	●																							
FS	●																							
STEXT	●																							
XTRACE	●																							
DFLAGS	●																							
DEBUG	●																							
DATA	●																							
CSTK																								
CRCCOM	●																							
COM SCS	●																							
COM PTR	●							●																
COMOUT	●																							
CLOOK																								
AGPK	●																							
AGPD	●																							
AFM	●																							
ACFRAG	●						●																	
AAPK	●																							

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	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITPTR	IODEV	JJOPT	LIMITS	MASK	MODVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD	ALTABL
BDALT																																					●
BDLEX						●																															
BDERK											●																										
BDPARS																																					
BCKDAT																																					
BNCMDPR																																					
BNCONHD																																					
BNCONLS																																					
BNCONTC																																					
BNEALLE																																					
BNNOTRD																																					
BNNWTRK																																					
BNPONBB																																					
BNPONBD																																					
BNPONDA																																					
BNPONCP																																					
BNPONEA																																					
BNPONED																																					
[illegible]NSS																																					
BNREC[illegible]V																																					
[illegible]																																					
[illegible]																																					
[illegible]																																					
[illegible]																																					

AD-A107 916 BDM CORP MCLEAN VA F/G 15/3
MODULAR AIR DEFENSE EFFECTIVENESS MODEL, PROGRAM DOCUMENTATION --ETC(U)
JAN 80 M FILTEAU, B MACALEER, J T HAWKINS DNA001-79-C-0230
UNCLASSIFIED BDM/W-79-646-TR-VOL-2 DNA-5594F-2 NL

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	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITPTR	IODEV	JJOPT	LIMITS	MASK	MODVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
BYALCOV																																				
BYCMDPR																																				
BYCONHD																																				
BYCONLS																																				
BYCONIC																																				
BYENDPS																																				
BYHEDUP																																				
BYNOTRD																																				
BYNWTRK																																				
BYPASUP																																				
BYPONER																																				
BYPONED																																				
BYPONRI																																				
BYPONRS																																				
BYPONTM																																				
BYTKCHK																																				
BYUPDAT																																				
CANCALO																																				
CANDTGT																			●					●						●			●			
CENTER																																				
CEEYCRC																																				
CHKCOV																																				
CHKLAST																																				
CLIST	●	●	●	●	●		●	●	●			●	●				●	●	●			●		●			●	●		●	●	●	●	●		

NO COMMON BLOCKS

	CLOSCOR	CNACTTK	CODE01	CODE03	CODE05	CODE18	COMMAND	COMMO	CONTROL	CORBOUN	COVAPLY	CRCDES	CRCEVNT	CRCKIL	CRCLOSS	CRCSET	CRCTHNK	CRCTRAK	CRC2INT	CREATE	CRETMI	DECDMS	DECRATO	DELADD	NO COMMON BLOCKS
CHOLD																									
TYPES																									
TRACK																									
THTRPLN	●		●	●	●	●															●				
STATBD																									
SPSTAT																									
SPACE	●		●	●	●	●			●	●										●	●			●	
SEMINFO			●	●	●	●																			
SAMPTRS																									
SAMPK																									
PATH																									
MXMIS																									
MODVAR			●	●	●	●															●				
MASK																									
LIMITS																									
JJOPT																									
IODEV																									
INITPTR	●									●											●				
HALF									●																
FS			●	●	●	●														●					
STEXT																									
XTRACE																									
DFLAGS																									
DEBUG																									
DATA																									
CSTK			●	●	●	●																			
CRCCOM																									
COM SCS			●	●	●	●			●															●	
COM PTR			●	●	●	●																			
COMOUT			●	●	●	●																			
CLOOK			●	●	●	●																			
AGPK																									
AGPD																									
AFM																									
ACFRAG																									
AAPK																									

	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITPTR	IODEV	JJOPT	LIMITS	MASK	MODVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
DESTROY																																				
DETECT																																				
DGTSHX*																																				
DILOUT																																				
DLYACT																																				
DMSDEC*																																				
DOGFITE																																				
DOGTHNK																																				
DROPBLK																							●								●					
DROPPOS																																				
DROPPS2																																				
ENGAGE																																				
ENTRYP													●																							
ENTSTAT													●																							
EXITP													●																							
FELDEL																																				
FETCH	●	●	●	●	●		●	●	●	●		●	●				●	●	●			●	●	●	●		●	●	●	●	●	●	●	●	●	●
FILERUP																																				
FILTER																																				
FINDBLK																							●							●						
FINDFLT																								●						●			●			
FINDIT																																				
FIRECHK																																				
FLITE																																				

*NO COMMON BLOCKS

	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITPTR	IODEV	JJOPT	LIMITS	MASK	MODVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
FLTGEOM																													●							
FLTWYPE																																				
FLY																																				
FLYSEE																																				
FORMTGT																			●										●				●			
FSDUMP													●				●												●							
FSINIT																	●													●						
FUELCHK																																				
GETHEX								●																					●							
GETPTRS																			●					●					●							
GIMME																	●					●							●	●						
GNDLOOK																																				
GOGETEM																																				
GOTOAB																																				
HANDZPT																																				
HEXADD'																																				
HEXCHZ																													●							
HEXINV'																																				
HEXMLT'																																				
HEXMOVE																																				
HEXMULT'																																				
HISTORY																													●						●	
HETPNT									●								●	●																	●	
HOLD	●	●	●	●	●		●	●	●	●		●	●				●	●	●			●	●	●	●		●	●	●	●	●	●	●	●	●	●

NO COMMON BLOCKS

	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITPTR	IODEV	JJOPT	LIMITS	MASK	MODVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
HXDGTS*																																				
HXMLT2*																																				
IJ2HX*																																				
INDEX																																				
INIT									●								●													●						
INITACO																														●						
INRANGE																																				
INSECT																																				
INSERT																																				
INTASIN																																				
INTFIND																																				
INTRFLY																																				
INT2CRC																																				
IPJI																						●								●						
JGESUIT																														●						
JTJ			●																																	
JUGGLE*																																				
KILFLIT																																				
KOMPARE																														●						
LCMLOC*																																				
LINEX*																																				
LNPLOT*																																				
LOADPL							●																							●						
LOSRADR																																				

*NO COMMON BLOCKS

	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITPTR	IODEV	JJOPT	LIMITS	MASK	MODVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
LTREE									●																					●						
MASKER'																																				
MESAGE'																																				
MESBILD																																				
NAYBOR																																				
NEWMOVE																																				
NEWPERC																																				
NOWUCH																														●						
NUKBLND																																				
OPTPTH																														●						
OTHRDAT	●			●	●			●												●					●		●			●						
OUTA																														●						
OUTPTRS																			●					●						●						
PACK																	●							●												
PAGE'																																				
PATDEC																																				
PDLOUT																																				
PELADD																														●						
PERCEPT																																				
PLAN																			●											●						
PLANOUT																	●						●							●						
PONDER																																				
PREPAFU																																				
PRIORTY																																				

' NO COMMON BLOCKS

	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITFTR	IODEV	JJOPT	LIMITS	MASK	MODVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
PTPONER																																				
PTRAND																																				
PTREE									●																					●						
READIL																																				
RECCON																																				
RECER													●																							
RECORD																																				
REDEBRF																																				
RELEASE																	●					●		●						●	●					
RELIST																																				
RELOAD																																				
RELOCAT																																				
RESHE																																				
RENDEVU																															●					
RESUPLY																																				
REVISE																			●												●					
RITEF																																				
RITEP																															●					
RITER																																				
REABDB																															●					
RECORD																															●					
REMAKE																															●					
RERAID																			●												●					
RETGTAK																															●					

NO COMMON BLOCKS

	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA
RLTGTYP												
RLWAVE												
RONDSEE												
ROUTER												●
SAMATON												
SAMPRCM												
SAMSEE												
SAMWYPE												
SCHEDUL	●											
SCHTAB												
SDIGEST												
SEEKENG												
SEEKP												
SEEKTAC												
SEEKTFU												
SELECT								●				
SEMANT					●	●	●	●		●		
SETASSN												
SHRKILL												
SHUFFLE												
SKSBTRK												
SNAP												
SRCHPI												
SSLI												

	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALT	INITPTR	IODEV	JJOPT	LIMITS	MASK	MODVAR
RLTGTYP												
RLWAVE												
RONDSEE												
ROUTER												
SAMATON												
SAMPRCM												
SAMSEE												
SAMWYPE												
SCHEDUL						●					●	
SCHTAB												
SDIGEST												
SEEKENG												
SEEKP												
SEEKTAC												
SEEKTFU												
SELECT				●						●	●	
SEMANT				●			●				●	
SETASSN												
SHRKILL												
SHUFFLE												
SKSBTRK												
SNAP										●		
SRCHPI												
SSLI												

	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
RLTGTYP					●							
RLWAVE					●							
RONDSEE												
ROUTER												
SAMATON												
SAMPRCM												
SAMSEE												
SAMWYPE												
SCHEDUL					●			●				
SCHTAB												●
SDIGEST												
SEEKENG												
SEEKP												
SEEKTAC												
SEEKTFU												
SELECT					●		●					
SEMANT				●	●				●			
SETASSN												
SHRKILL												
SHUFFLE												
SKSBTRK												
SNAP					●							
SRCHPI					●							
SSLI												

NO COMMON BLOCKS

	STATPAK	STICK	TABOUT	TABOUT2	TERMACO	TFLYCRC	TGTGONE	TGTHEX	TGTDST	THH2PS	THTRPLN	THX2XY'	TH2HX'	TLL2HX'	TLL2XY'	TOADR	TOWER	TRACE	TRKCHEK	TRYSHOT	TTIME'	TXY2HX'	TXY2HXL'	TXY2LL'
CHOLD																								
TYPES																								
TRACK																								
THTRPLN							●				●													
STATBD																								
SPSTAT																								
SPACE							●		●	●	●													
SEMINFO																								
SAMPTRS																								
SAMPK																								
PATH																								
MXMIS																								
MODVAR											●													
MASK																								
LIMITS																								
JJOPT											●													
IODEV																								
INITPTR											●													
HALT											●													
FS																								
STEXT																								
XTRACE																								
DFLAGS																								
DEBUG																								
DATA																								
CSTK																								
CRCCOM																								
COM SCS																								
COM PTR																								
COMOUT																								
CLOOK																								
AGPK																								
AGPD																								
AFM																								
ACFRAG																								
AAPK																								

' NO COMMON BLOCKS

	AAPK	ACFRAG	AFM	AGPD	AGPK	CLOOK	COMOUT	COM PTR	COM SCS	CRCCOM	CSTK	DATA	DEBUG	DFLAGS	XTRACE	STEXT	FS	HALI	INITPTR	IODEV	JJOPT	LIMITS	MASK	MCDVAR	MXMIS	PATH	SAMPK	SAMPTRS	SEMINFO	SPACE	SPSTAT	STATBD	THTRPLN	TRACK	TYPES	CHOLD
UTSUB2																																				
UMPIRE																																				
UNLINK																																				
UNSNAP																							●							●						
UNSTAT																																				
UORSUB																																				
UOLLOAD																														●						
WIPEOUT																																				
WTHDRAW																																				
XPAA																																				
XPD																																				
XPK																																				
XSHIFT																																				
XY2HX																																				
YANK																																				
LTRMRG									●																					●						
UNPACK																	●						●													
DBGREAD													●							●																
ICHECK													●							●										●						
ITRAP																														●						

NO COMMON BLOCKS

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AODB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
MADEM																						●													
ABQUEUE	●	●	●		●			●	●													●										●			
ABSEE																																			
ABVSCOR	●		●	●						●																									
AB2CRC																																			
ACCEPT																																			
ACFRAG																								●											
ADASASS			●									●						●		●									●	●					
ADDBLOK																																			
AIRTHNK																																			
ALLOBAT																																			
ALLOFU																																			
ALLOPAT																																			
AMMOCHK																																			
ASSIGN																																			
ATKASES																																			
ATTACK																																			
AUTOPRI																																			
AVAILBL																																			
AZILIM																																			
BADMOVE																																			
BATCEAS																																			
BATTCOV																																			
BATTOUT																																			

NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
BDALT *																																			
BDLEX *																																			
BDLRK *																																			
BDPARS *																																			
BLKDAT *																																			
BNCMDPR																																			
BNCONHD																																			
BNCONLS																																			
BNCONTC																																			
BNLAL:E																																			
BNNOTRD																																			
BNNWTRK																																			
BNPONBB																																			
BNPONBD																																			
BNPONDA																																			
BNPONEP																																			
BNPONFA																																			
BNPONFD																																			
BNPONSS																																			
BNRECOV																																			
BOCTINK																																			
BINASIN																																			
BTN2CRC																																			
BTRYTNK																																			

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
BYALCOV																																			
BYCMDPR																																			
BYCONHD																																			
BYCONLS																																			
BYCONTC																																			
BYENDPS																																			
BYHEDUP																																			
BYNOTRD																																			
BYNWTRK																																			
BYPASUP																																			
BYPONER																																			
BYPONFD																																			
BYPONRL																																			
BYPONRS																																			
BYPONTM																																			
BYTKCHK																																			
BYUPDAT																																			
CANCALO																																			
CANDTGT															●										●										
CENTER *																																			
CFLYCRC																																			
CHKCOV																																			
CHKLAST																																			
CLIST *																																			

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
CLOSCOR																										●									
CNACTTK																																			
CODE01																																			
CODE03																						●													
CODE05												●		●								●								●					
CODE18																						●													
COMMAND																																			
COMMO																																			
CONTROL																																			
CORBOUN																									●	●									
COVAPLY																																			
CRCDIES																																			
CRCEVNT																																			
CRCKIL																																			
CRCLOSS																																			
CRCSEE																																			
CRCTHNK																																			
CRCTRAK																																			
CRC2INT																																			
CREATE																						●													
CRFLTML					●											●						●													
DECDMS *																																			
DECRALO																																			
DELADD *																																			

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLU	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
DESTROY																																			
DETECT																																			
DGTSHX*																																			
DILOUT																																			
DLYACT																																			
DMSDEC*																																			
DOGFITE																																			
DOGTHNK																																			
DROPBLK																																			
DROPPOS																																			
DROPPS2																																			
ENGAGE																																			
ENTRYP*																																			
ENTSTAT*																																			
EXITP*																																			
FELDEL																																			
FETCH*																																			
FILERUP																																			
FILTER																																			
FINDBLK*																																			
FINDFLT				●	●					●															●										
FINDIT																																			
FIRECHK																																			
FLITE																																			

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
FLTGEOM																●																			
FLTWYPE																																			
FLY																																			
FLYSEE																																			
FORMTGT										●																●									
FSDUMP *																																			
FSINIT																																			
FUELCHK																																			
GETHEX																																			
GETPTRS																						●													
GIMME *																																			
GNDLOOK																																			
GOGETEM																																			
GOTOAB																																			
HANDZPT																																			
HEXADD *																																			
HEXCHZ																																			
HEXINV *																																			
HEXMLT *																																			
HEXMOVE																																			
HEXMULT *																																			
HISTORY																						●													
HLTPNT *																																			
HOLD *																																			

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
HXDGTS *																																			
HXMLT2 *																																			
IJ2HX *																																			
INDEX																																			
INIT																																			
INITACQ					●	●						●									●														
INRANGE																																			
INSECT																																			
INSERT																																			
INTASIN																																			
INTFIND																																			
INTRFLY																																			
INT2CRC																																			
IPJL *																																			
JGESUIT																								●	●										
JTJ *																																			
JUGGLE *																																			
KILFLIT																																			
KOMPARE *																																			
LCMLOC *																																			
LINEX *																																			
LNPLOT *																																			
LOADPL																																			
LOSRADR																																			

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
LTREE																																			
MASKER ·																																			
MESAGE ·																																			
MESBILD																																			
NAYBOR																																			
NEWMOVE																																			
NEWPERC																																			
NOWUCIT																																			
NUKBLND																																			
OPTPTH																																			
OTHRDAT		●			●			●	●			●		●																		●	●		
OUTA ·																																			
OUTPTRS																																			
PACK ·																																			
PAGE ·																																			
PATDEC																																			
PDLOUT																																			
PELADD																																			
PERCEPT																																			
PLAN ·																																			
PLANOUT					●												●							●											
PONDER																																			
PREPAFU																																			
PRIORITY																																			

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
PTPNER																																			
PTRAND																																			
PTREE *																																			
READIL																																			
RECCON *																																			
RECER *																																			
RECORD																																			
REDEBRF																																			
RELEASE *																																			
RELIST *																																			
RELOAD																																			
RELOCAT																																			
RELSIIL																																			
RENDEVU																																			
RESUPLY																																			
REVISE			●																			●													
RITEI *																																			
RITEP *																																			
RITER																																			
RLABDB				●						●																									
RLCORD				●																						●									
RLFMAKT																																			
RLRAID																										●									
RLTGTAK													●																						

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBCRD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
RLTGTYP																	●																		
RLWAVE																																			
RONDSEE																																			
ROUTER *																																			
SAMATON																																			
SAMPRCM																																			
SAMSEE																																			
SAMWYPE																																			
SCHEDUL																	●									●									
SCHTAB *																																			
SDIGEST																																			
SEEKENG																																			
SEEKP																																			
SEEKTAC																																			
SEEKTFU																																			
SELECT																																			
SEMANT																				●		●				●									
SETASSN																																			
SHRKILL																																			
SHUFFLE *																																			
SKSBTRK																																			
SNAP																																			
SRCHPL																						●													
SSIL																																			

*NO DATA STRUCTURES

	ABINFO	ARQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
STATPAK																																			
STICK																																			
TABOUT																																			
TABOUT2																																			
TERMACQ																																			
TFLYCRC																																			
TGTGONE																																			
TGTHEX																																			
TGTLIST																						●													
THH2PS																																			
THTRPLN																																			
THX2XY*																																			
TH2HX*																																			
TLL2HX*																																			
TLL2XY*																																			
TOADIL																																			
TOWER																																			
TRACE*																																			
TRKCHEK																																			
TRYSHOT																																			
TTIME*																																			
TXY2HX*																																			
TXY2HXL*																																			
TXY2LL*																																			

*NO DATA STRUCTURES

	ABINFO	ABQUEDB	ABSTATUS	ABVCR	ACDB	ACQBUF	ACQDEVICE	ACRFTLIST	ACRFTONAB	ACTAB	ADDLINK	ADSITEDB	ALLOCATE	AQDB	ARCFTSAW	ARCFTSTATUS	ATTACK BLOK	BOCSTAT	BTRYDIL	BTRYSTAT	BUFFER	C2	C2 SIDE	COMMAND	CONSTBLOK	CORRIDOR BLOK	CRCSEE BLUE	CRC SEERED	CRCSEES	CRCSUBORD	DAQE	DATBLOK	DAT BUF	DBCLASS BLOK	DIB
ULSUB2																																			
UMPIRE																																			
UNLINK																																			
UNSNAP																																			
UNSTAT																																			
UOILSUB																																			
UOLLOAD																						●													
WIPEOUT																																			
WTHDRAW																																			
XPAA																																			
XPD																																			
XPK																																			
XSHIFT*																																			
XY2HX																																			
YANK																																			
LTRMRG																																			
UNPACK*																																			
DBGREAD*																																			
ICHECK*																																			

*NO DATA STRUCTURES

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
MADEM																																		●	
ABQUEUE																																			
ABSEE																																			
ABVSCOR																		●																	
AB2CRC																																			
ACCEPT																																			
ACFRAG						●	●		●	●							●			●							●								
ADASASS								●																●											
ADDBLOK																																			
AIRTHNK																																			
ALLOBAT																																			
ALLOFU																																			
ALLOPAT																																			
AMMOCHK																																			
ASSIGN																																			
ATKASES																																			
ATTACK																																			
AUTOPRI																																			
AVAILBL												●														●									
AZILIM																																			
BADMOVE																																			
BATCEAS																																			
BATTCOV																																			
BATTOUT																																			

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
BDALT																																			
BDLEX																																			
BDLRK																																			
BDPARS																																			
BLKDAT																																			
BNCMDPR																																			
BNCONHD																																			
BNCONLS																																			
BNCONTC																																			
BNLALLE																																			
BNNOTRD																																			
BNNWTRK																																			
BNPONBB																																			
BNPONBD																																			
BNPONDA																																			
BNPONFP																																			
BNPONFA																																			
BNPON FD																																			
BNPONSS																																			
BNRECOV																																			
BOCTINK																																			
BTNASIN																																			
BTN2CRC																																			
BTRYTNK																																			

	BYALCOV	BYCMOPR	BYCONHD	BYCONIS	BYCONIC	BYENDPS	BYHEDUP	BYNOTRD	BYNWTRK	BYPASUP	BYPONER	BYPONRD	BYPONRI	BYPONRS	BYPONTM	BYTKCHK	BYUPDAT	CANCALO	CANDTGT	CENTER	CFLYCHC	CHKCOV	CHKLAST	CLIST
DIL																								
DUMMY BLOCK																								
ENGAGE																								
EVENT																								
EYEBALL																								
FAKTGBLOK																								
FDBDBLOK																			●					
FIRE UNIT																								
FLTAKTBLOK																								
FLTDB																								
FMFLT DB																								
FOREST																			●					
FORMATION																								
FORMATION BLOK																			●					
FORTGT BUFFER																								
HEAD BLOCK																								
HEX																			●					
HEXBLOK																								
HEXELEV																								
HEXLINK																								
LEFTREE																								
LINK																								
LOAD																								
MESSAGE																								
MUN																								
NOAVAIL BLOK																								
ORDERS																								
PAL																								
PAYBUF																								
PAYLDDBLOK																								
PAYLOAD																								
PER LIST																								
PLAYER BUFFER																								
PL BUFFER																								
PLYLST																								

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST
CLOSCOR												
CNACTTK												
CODE01												
CODE03												
CODE05												
CODE18												
COMMAND												
COMMO												
CONTROL				●								
CORBOUN												
COVAPLY												
CRCDIES												
CRCEVNT												
CRCKIL												
CRCLOSS												
CRCSEE												
CRCTHNK												
CRCTRAK												
CRC2INT												
CREATE												
CRFLTMI							●			●		
DECDMS												
DECRALO												
DELADD				●								

	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE
CLOSCOR					●							
CNACTTK												
CODE01			●		●		●					
CODE03												
CODE05					●							
CODE18					●							
COMMAND												
COMMO												
CONTROL									●			
CORBOUN					●	●		●				
COVAPLY												
CRCDIES												
CRCEVNT												
CRCKIL												
CRCLOSS												
CRCSEE												
CRCTHNK												
CRCTRAK												
CRC2INT												
CREATE												
CRFLTMI					●						●	
DECDMS												
DECRALO												
DELADD									●			

	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
CLOSCOR											
CNACTTK											
CODE01									●	●	
CODE03											
CODE05											
CODE18											
COMMAND											
COMMO											
CONTROL											
CORBOUN											
COVAPLY											
CRCDIES											
CRCEVNT											
CRCKIL											
CRCLOSS											
CRCSEE											
CRCTHNK											
CRCTRAK											
CRC2INT											
CREATE											
CRFLTMI	●					●	●				
DECDMS											
DECRALO											
DELADD											

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDR JBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
DESTROY																																			
DETECT																																			
DGTSHX																																			
DILOUT																																			
DLYACT																																			
DMSDEC																																			
DOGFITE																																			
DOGTHNK																																			
DROPBLK																																			
DROPPOS																																			
DROPPS2																																			
ENGAGE																																			
ENTRYP																																			
ENTSTAT																																			
EXITP																																			
FELDEL																																			
FETCH																																			
FILERUP																																			
FILTER																																			
FINDBLK																																			
FINDFLT						●			●	●							●																		
FINDIT																																			
FIRECHK																																			
FLITE																																			

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
FLTGEOM																																			
FLTWYPE																																			
FLY																																			
FLYSEE																																			
FORMTGT						●	●		●	●	●			●																					
FSDUMP																																			
FSINIT																																			
FUELCHK																																			
GETHEX																	●		●																
GETPTRS																																			
GIMME																																			
GNDLOOK																																			
GOGETEM																																			
GOTOAB																																			
HANDZPT																																			
HEXADD																																			
HEXCHZ																	●																		
HEXINV																																			
HEXMLT																																			
HEXMOVE																																			
HEXMULT																																			
HISTORY																	●																		
HITPNT																																			
HOLD																																			

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
HXDGTS																																			
HXMLT2																																			
IJ2HX																																			
INDEX																																			
INIT																					●														
INITACQ																	●																		
INRANGE																																			
INSECT																																			
INSERT																																			
INTASIN																																			
INTFIND																																			
INTRFLY																																			
INT2CRC																																			
IPJL																																			
JGESUIT																	●																		
JTJ																																			
JUGGLE																																			
KILFLIT																																			
KOMPARE																																			
LCMLOC																																			
LINEX																																			
LNPLOT																																			
LOADPL																																	●		●
LOSRADR																																			

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
LTREE																					●														
MASKER																																			
MESAGE																																			
MESBILD																																			
NAYBOR																																			
NEWMOVE																																			
NEWPERC																																			
NOWUICIT																	●					●													
NUKBLND																																			
OPTPTH																				●															
OTHRDAT							●			●	●																		●	●	●				
OUTA																																			
OUTPTRS																	●																		
PACK																																			
PAGE																																			
PATDEC																																			
PDLOUT																																			
PELADD																																			
PEWCEPT																																			
PLAN																																			
PLANOUT						●	●		●	●							●																		
PONDER																																			
PREPAFD																																			
PRIORTY																																			

	PTPONER	PTRAND	PTREE	READIR	RECCON	RECER	RECORD	REDEBRF	RELEASE	RELIST	RELOAD	RELOCAT	RELSIL	RENDEVU	RESUPLY	REVISE	RITEI	RITEP	RITER	RLABDB	RECORD	REFMAKT	RERAID	RETGTAK
PLYLST																								
PL BUFFER																								
PLAYER BUFFER																								
PER LIST																								
PAYLOAD																								
PAYLDDBLOK																								
PAYBUF																								
PAL																								
ORDERS																								
NOAVAIL BLOK																								
MUN																								
MESSAGE																								
LOAD																								
LINK																								
LEFTREE																								
HEXLINK																					●			
HEXELEV																								
HEXBLOK																					●			
HEX														●										
HEAD BLOCK																								
FORTGT BUFFER																								
FORMATION BLOK																								
FORMATION																●								
FOREST																								
FMFLT DB																								
FLTDB																●								
FLTAKTBLOK																●								
FIRE UNIT														●								●		
FDBDBLOK																								
FAKTGBLOK																●								
EYEBALL														●								●		●
EVENT																								
ENGAGE																								
DUMMY BLOCK																								
DIL																								

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
RETGTYP														●																					
REWAVE																																			
RONDSEL																																			
ROUTER																																			
SAMATON																																			
SAMPRCM																																			
SAMSEL																																			
SAMWYPE																																			
SCHEDUL						●	●		●								●	●		●															
SCHTAB																																			
SDIGEST																																			
SEEKENG																																			
SEEKP																																			
SEEKTAC																																			
SEEKTPU																																			
SELECT				●																															
SEMANT														●			●		●															●	
SETASSN																																			
SHRKILL																																			
SHUFFLE																																			
SKSBTRK																																			
SNAP																																			
SRCHPF																																	●	●	●
SSEL																																			

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
STATPAK																																			
STICK																																			
TABOUT																																			
TABOUT2																																			
TERMACQ																																			
TFLYCRC																																			
TGTGONE												●														●									
TGTHEX																																			
TGTLIST												●					●																		
THH2PS																	●																		
THTRPLN												●		●																					
THX2XY																																			
TH2HX																																			
TLL2HX																																			
TLL2XY																																			
T[illegible]ADIL																																			
TOWER																																			
TRACE																																			
TRKCHEK																																			
TRYSHOT																																			
TTIME																																			
TXY2HX																																			
TXY2HXL																																			
TXY2LL																																			

	DIL	DUMMY BLOCK	ENGAGE	EVENT	EYEBALL	FAKTGBLOK	FDBDBLOK	FIRE UNIT	FLTAKTBLOK	FLTDB	FMFLT DB	FOREST	FORMATION	FORMATION BLOK	FORTGT BUFFER	HEAD BLOCK	HEX	HEXBLOK	HEXELEV	HEXLINK	LEFTREE	LINK	LOAD	MESSAGE	MUN	NOAVAIL BLOK	ORDERS	PAL	PAYBUF	PAYLDDBLOK	PAYLOAD	PER LIST	PLAYER BUFFER	PL BUFFER	PLYLST
ULSUB2																																			
UMPIRE																																			
UNLINK																																			
UNSNAP																																			
UNSTAT																																			
UOILSUB																																			
UOLLOAD																	●					●													
WIPEOUT																																			
WTHDRAW																																			
XPAA																																			
XPD																																			
XPK																																			
XSHIFT																																			
XY2HX																																			
YANK																																			
LTRMRG																					●														
UNPACK																																			
DBGREAD																																			
ICHECK																																			

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN													
MADEM																																			
ABQUEUE			●	●		●	●																												
ABSEE																																			
ABVSCOR							●																												
AB2CRC																																			
ACCEPT																																			
ACFRAG							●	●																											
ADASASS							●	●					●	●	●																				
ADDBLOK																																			
AIRTHNK																																			
ALLOBAT																																			
ALLOFU																																			
ALLOPAT																																			
AMMOCHK																																			
ASSIGN																																			
ATKASES																																			
ATTACK																																			
AUTOPRI																																			
AVAILBL												●																							
AZILIM																																			
BADMOVE																																			
BATCEAS																																			
BATTCOV																																			
BATTOUT																																			

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN													
BDALT																																			
BDLEX																																			
BDLRK																																			
BDPARS																																			
BLKDAT																																			
BNCMDPR																																			
BNCONHD																																			
BNCONLS																																			
BNCONTC																																			
BNLALLE																																			
BNNOTRD																																			
BNNWTRK																																			
BNPONBB																																			
BNPONBD																																			
BNPONDA																																			
BNPONEP																																			
BNPONFA																																			
BNPONFD																																			
BNPONSS																																			
BNRECOV																																			
BOCTINK																																			
BTNASIN																																			
BTN2CRC																																			
BTRYTNK																																			

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN
BYALCOV																						
BYCMDPR																						
BYCONHD																						
BYCONLS																						
BYCONTC																						
BYENDPS																						
BYHEDUP																						
BYNOTRD																						
BYNWTRK																						
BYPASUP																						
BYPONER																						
BYPONFD																						
BYPONRL																						
BYPONRS																						
BYPONTM																						
BYTKCHK																						
BYUPDAT																						
CANCALO																						
CANDTGT												●				●						
CENTER																						
CFLYCRC																						
CHKCOV																						
CHKLAST																						
CLIST																						

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN
CLOSCOR					●																	
CNACTTK																						
CODE01							●										●					
CODE03																						
CODE05							●	●					●	●	●							
CODE18							●															
COMMAND																						
COMMO																						
CONTROL																						
CORBOUN					●																	
COVAPLY																						
CRCDIES																						
CRCEVNT																						
CRCKIL																						
CRCLOSS																						
CRCSEE																						
CRCTHNK																						
CRCTRAK																						
CRC2INT																						
CREATE							●	●														
CRFLTML	●						●	●	●													
DECDMS																						
DECRALO																						
DELADD																						

	DESTROY	DETECT	DGTSHX	DILOUT	DIYACT	DMSDEC	DOGFITE	DOGTHNK	DROPBLK	DROPPOS	DROPPS2	ENGAGE	ENTRYP	ENTSTAT	EXITP	FELDEL	FETCH	FILERUP	FILTER	FINDBLK	FINDELT	FINDIT	FIRECHK	FLITE
WINGMAN																								
WAVE BLOK																								
TTD BLOK																								
TGT PTREE																								
TGT LIST BLOK																								
TARGET BUFFER																								
TARGET BLOK																								
TARGET																								
SUBTYPE																								
SUBLIST																								
SUB																								
STDBLOK																								
SOURCE																					●			
SEER																								
SEE BUF																								
SDB																								
SB																								
READY QUE																					●			
RAID BLOK																								
QUEUES																								
QUESTAT																								
PU BUFFER																								
PROFILED BLOK																								

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN
FLTGEOM							●															
FLTWYPT																						
FLY																						
FLYSEE																						
FORMTGT					●							●				●						
FSDUMP																						
FSINIT																						
FUELCHK																						
GETHEX																						
GETPTRS							●	●														
GIMME																						
GNDLOOK																						
GOGETEM																						
GOTOAB																						
HANDZPT																						
HEXADD																						
HEXCHZ																						
HEXINV																						
HEXNET																						
HEXMOVE																						
HEXSDLT																						
HISTORY							●															
HLTPNT																						
HOLD																						

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN
HXDGTS																						
HXMIT2																						
I2HX																						
INDEX																						
INIT																						
INITACQ							●															
INRANGE																						
INSECT																						
INSERT																						
INTASIN																						
INTFIND																						
INTRFLY																						
INTZCRC																						
IPH																						
JGFSUIT																						
JTJ																						
JUGGLE																						
KILFIT																						
KOMPARE																						
LCMLOC																						
LINEX																						
LNPLOT																						
LOADPL																						
LOSRADR																						

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN
LTREE																						
MASKER																						
MESAGE																						
MESBLD																						
NAYBOR																						
NEWMOVE																						
NEWPERC																						
NOWHIT		●																				
NUKBEND																						
OPTPTH																						
OTHRDAT	●																					
OUTA																						
OUTPTRS																						
PACK																						
PAGE																						
PATDEC																						
PDLOUT																						
PLEADD												●							●			
PERCEPT																						
PLAN																						
PLANOUT					●		●					●				●					●	
PONDER																						
PREPATH																						
PRIORITY																						

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN
PTPONER																						
PTRAND																						
PTREF																						
READB																						
RECCON																						
RECER																						
RECORD																						
REDEBRI																						
RELEASE																						
RELIST																						
RELOAD																						
RELOCAT																						
RESHIE																						
RENDEVU							●															
RESUPLY																						
REVISE					●		●									●					●	
RITEF																						
RITEP																						
RITER																						
RLABDB																						
RLCORD																						
RLEMAKE																						
RERAID					●																●	
RETGTAK																						

	RLTGTYP	RLWAVE	RNDSEE	ROUTER	SAMATON	SAMPRGM	SAMSEE	SAMWYPE	SCHEDUL	SCHTAB	SDIGEST	SEEKENG	SEEKP	SEEKTAC	SEEKTEU	SELECT	SEMANT	SETASSN	SHRKILL	SHUFFLE	SKSBRK	SNAP	SRCHPL	SSII
WINGMAN																								
WAVE BLOK																								
TTD BLOK		●							●								●							
TGT PTREE																								
TARGET LIST BLOK																								
TARGET BUFFER																								
TARGET BLOK																								
SUBTYPE	●	●							●								●							
SUBLIST																								
SUB																								
STDBLOK																								
SOURCE									●															
SEER																								
SEE BUF																								
SDB																								
SB																								
READY QUE									●								●							
RAID BLOK																	●							
QUEUES																								
QUESTAT																	●							
QUESTAR																								
PU BUFFER																								
PROFILED BLOK																								

	PROFILED BLOK	PU BUFFER	QUESTAT	QUEUES	RAID BLOK	READY QUE	SB	SDB	SEE BUF	SEER	SOURCE	STDBLOK	SUB	SUBLIST	SUBTYPE	TARGET BLOK	TARGET BUFFER	TARGET LIST BLOK	TGT PTREE	TTD BLOK	WAVE BLOK	WINGMAN
STATPAK																						
STICK																						
TABOUT																						
TABOUT2																						
TERMACO																						
TELYCRC																						
TGTGONE												●										
TGTHEX																						
TGTHEST							●					●						●	●	●		
THH2PS																						
THRRPLN					●			●				●				●			●		●	
THX2XY																						
TH2HX																						
TLL2HX																						
TLL2XY																						
TOADH																						
TOWER																						
TRACE																						
TRKCHEK																						
TRYSHOT																						
TTIME																						
TXY2HX																						
TXY2HXL																						
TXY2LL																						

	ULSUB2	UMPIRE	UNLINK	UNSNAP	UNSTAT	UOLSUB	UOLLOAD	WIPEOUT	WITHDRAW	XPAA	XPD	XPK	XSHIFT	XY2HX	YANK	LTHMRG	UNPACK	DBGREAD	ICHECK
PROFILED BLOK																			
PU BUFFER							●												
QUESTAT																			
QUEUES																			
RAID BLOK																			
READY QUE																			
SB							●												
SDB																			
SEE BUF																			
SEER																			
SOURCE																			
STDBLOK																			
SUB																			
SUBLIST																			
SUBTYPE																			
TARGET BLOK																			
TARGET BUFFER																			
TARGET LIST BLOK																			
TGT PTREE																			
TTD BLOK																			
WAVE BLOK																			
WINGMAN																			

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8